Protecting Textiles from Insects with Traditional Plant Methods

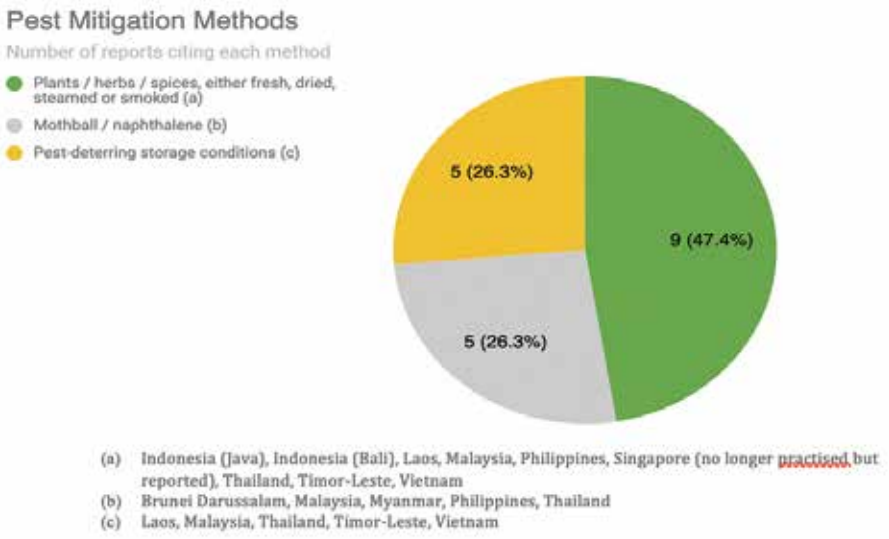
By Julia M. Brennan and Linh Anh Moreau

How effective is the use of natural-plant based remedies to repel insects and protect textiles? Pest mitigation companies, homeowner associations, and prevalent practice, encourage the use of mothballs and chemicals. Call the pest man! However, there has been a distinct change in the conservation practice, away from chemical based insect treatments, to integrated pest management IPM, which holistically deals with the site, collections, infestations through regular monitoring and cleaning of spaces, use of sticky traps as indicators, and targeted chemical use as a last resort. IPM is based on hard work, not quick fixes; but it does work. In addition, the use of 'home' remedies is common, and varies according to what is locally available or what grandma used. Some well known remedies include 'pomander balls', cedar chests, lavender sachets, vetiver stalks, citronella, and cloves. Can these natural non-toxic plant based materials contribute to a successful routine of caring for textiles in the home? This summary focuses on the most common practices, and how are they best used to protect cellulose based fibers including cotton, bast and papers, and animal based fibers such as silk, wool and furs.

General Results

A broad project to research traditional methods and materials produced a wealth of information about the use indigenous plants specifically for the care and preservation of textiles —seeds, leaves, roots, bark, and juices for cleaning, stain removal, mold abatement, odor control and insect mitigation. Over a period of three years, thirty textile specialists and conservators from 10 countries[1] engaged in fieldwork, documentation and collection of traditional materials, methods, and memories, and workshops for analysis and testing. In the overall study, there are 62 plants cited, 16 of which are for insect mitigation.

In many parts of the world local 'tried and true' plant remedies seem to help repel and reduce the infestations and damage from little critters. This includes cockroaches, ants, wasps, bees, termites, silverfish, crickets, moths, carpet beetles, flour moths and beetles, mosquitos, and rodents. Historically, and even today, traditional methods provide practical, affordable, safe, and often locally sustainable alternatives as insect deterrents, not eradication. However, these traditional practices and associated knowledge are rapidly being lost. Throughout modern Southeast Asia, a modest use



(a) Indonesia (Java), Indonesia (Bali), Laos, Malaysia, Philippines, Singapore (no longer practised but reported), Thailand, Timor-Leste, Vietnam
(b) Brunei Darussalam, Malaysia, Myanmar, Philippines, Thailand
(c) Laos, Malaysia, Thailand, Timor-Leste, Vietnam

Top to bottom: fresh soursop (Annona muricata) leaves, dried clove (Syzygium aromaticum) studs, dried peppercorns (Piper nigrum), and fresh betel (Piper betle) leaves. (Source: Benny Gratha)
Chili pepper (Capsicum frutescens) fruits and wild basil (Ocimum basilicum) leaves. (Source: Linh Anh Moreau)

of plant based insect mitigation is found in 70% of the countries. These include cloves, pandan leaves, peppercorns, citronella and tobacco leaves, as they are affordable and easily found. Traditionally, textiles are folded or rolled to fit inside a woven basket, clay pot, or placed in a storage trunk or cupboard, together with pouches of insect repelling dry herbs and spices, adjacent to, but not touching the textiles.

The use of these common herbs is actually more prevalent than mothballs or other chemical insecticides. The exception is museum settings, where custodians have been trained to use 'Western' methods. In a majority of the data, mothballs are commonly cited for insect control in institutions. Introduced as early 1900s by foreign business people, missionaries, and medical teams, they became the common "go-to" solution for insect infestations and a cheap alternative to herbal remedies. While the present day formula has changed, they remain a health risk, continue to off gas, and do not insects. Today, mothballs are made from dichlorobenzene rather than easily flammable naphthalene. However, it is well known that mothballs and other chemicals are toxic to humans. Very high concentrations of either chemical, in airtight sealed containers, trapping the fumes, are needed for mothballs to be effective in pest control. The mothballs, which start as a solid cake, break down into toxic vapor that permeates the textiles. If you smell mothballs, then you are inhaling the insecticide; the odor lingers when the textiles are used or worn. Without an airtight storage system, the fumes dissipate and escape, serve no purposes except to expose people in the household or institution.

Insect repelling plants and spices (selection)

The most prevalently used herbs throughout Southeast Asia contain similar organic compounds. Sesquiterpene, beta-caryophyllene, and/or linalool, terpenes produce essential oils with properties that repel insects. The application method of herbs is simple; wrap the fresh or dried herb in a small piece of cotton or mosquito mesh, making a small 'sachet'. Place it near the textiles, in the drawer, chest, closet, but NOT on the textiles. Because plant materials lose their potency and effectiveness overtime, replenishing with fresh herbs and spices has to be done on a regular basis, every several months.

- Fresh soursop (Annona muricata) leaves and pandan (Pandanus amaryllifolius) leaves. Used fresh.

- Dried materials such as clove (Syzygium aromaticum) studs, peppercorns (Piper nigrum), chili pepper (Capsicum frutescens) fruit, tobacco (Nicotiana tabacum) leaves, vetiver (Vetiveria zizanioides) roots, citronella stalks (Cymbopogon nardus), cinnamon (Cinnamomum burmannii) bark, betel (Piper betle) leaves, and pandan (Pandanus amaryllifolius) leaves can hang near the textiles.
- Basil (Ocimum basilicum) and patchouli (Pogostemon family) leavs were cited as cleaning agents, but bibliographical research reveals they also have insect-repelling properties, especially against mites and ticks. The leaves are mashed and mixed with water to produce natural detergents for cleaning and infusing textiles.
- To rid of cockroaches, place a bowl of vinegar in the cockroaches' pathway. (near a chest or closet)
- A common storage method is a wooden chest or 'sailor's chest' made of sandalwood (Santalum album) or camphor wood (Cinnamomum camphora), both a source of the essential oil linalool. Sandalwood is also a rich source of sesquiterpene, thus repelling insects.
- The most exotic and unexpected method cited was the use of peacock feathers – the eyes. The bright colors are produced by microscopic crystal-like structures, which cause different wavelengths of light to be filtered and reflected. This creates different iridescent hues and visual effects that scare away the insects! Put a peacock feather in your textile trunk!

Case Study: At Sri Aurobindo Ashram Archives and Research Library, in the seaside town of Pondicherry, eastern India, the team at the Archives Conservation Lab has incorporated traditional remedies into the care of the manuscripts, books, textiles, and objects. Because the climate so closely mimics artificial ageing tests that use aggravated conditions of heat, humidity and light to accelerate normal ageing processes of collections, the challenges of insect infestation and mold occurrences are year-round. Over the years the custodians have come to appreciate the discerning quality of traditional knowledge; many of the procedures used for the preservation of the collections come from the time-honored experience of others.

- **Tobacco leaves** (Nicotiana tabacum) are a deterrent to book lice.
- **Vasambu / Sweet Flag** (Acorus calamus) is used to repel cockroaches. Many libraries in India use the rhizome of sweet flag to protect palm-leaf manuscripts. Dry rhizomes, ground into powder, have a faint odor and contain 1.5%- 3.5% of the volatile oil, which has insecticidal properties. The powder is put into cloth sachets with the collections (Agrawal 1984).
- **Insect pellets made of maida** (white flour) & boric acid, 1:1 ratio, to deter silverfish and ants (placed on shelving with paper archives, dead ants are often found nearby). Mix equal portions of boric acid and flour with water into a dough. Break off small pieces and roll into balls, flatten into pellets and dry on a tray until hard.

Assortment of natural 'remedies' used at Sri Aurobindo Ashram Conservation Lab, including sachets of clove, tobacco, vasambu, and the little anti-silverfish flour and boric acid pellets. (source: Julia M Brennan)

Case study: Malaysia and Indonesia share the same historic crossroads of trade and developed sophisticated methods to preserve fine silks and cottons. Today, they both practice a method of perfuming or smoking textiles with ratus to "dry-clean", eliminate mold and mildew, prevent insect damage and dry the fabric out. The ratus, an incense-like cake that is burnt to create the smoke, is made of secret mixtures of herbs and spices, such as clove, nutmeg, cinnamon, sandalwood, vetiver. This age-old technique even has its own verb form, 'meratus', which means 'to smoke using ratus herbs'.

Though its origins are unknown, its use was prevalent in the courts or kratons of Java as a way to preserve and perfume the finest cloths of the princesses and courtesans. Here, there is a parallel with the court of Siam, where research revealed a vast array of herbs, spices and flowers used in smoking and distillations to "preserve" the textiles and enhance the wearer. These were not just any spices; these were enormously exclusive. Among the textiles most often preserved with ratus are songket, the costly, metallic and silk status pieces. The gold and silver threads, often gilded, pose a risk for any method of wet-cleaning. Thus, this passive procedure, which is insecticidal, antifungal, antibacterial, and smells divine, is **a truly moderate conservation practice. It features a preventive conservation approach and is still widely practiced.**

A tray of the secret ratus blend of herbs and spices and demonstration of meratus as a 'dry-cleaning' method by the late Ibu Nora Gunawan. The herbs are placed to smolder on burning coals, under the chicken basket. Cloths are laid one-by-one on the basket to absorb the smoke. (Source: Supriyadi)

Conclusion

Among the 16 plants identified by elders in the study, most can be found as dry spices in the kitchen or as fresh fragrant herbs at the local market (clove, cinnamon, pepper, chili pepper fruits, pandan, basil and betel leaves), while some can be sourced from a grower or farm (soursop tree leaves, tobacco leaves). The cross-referencing of these plants with available scientific literature supports the properties of these plants as insect deterrents, thanks to the powerful terpenes (beta-caryophyllene, linalool, limonene) emitting a strong smell and flavonoids released by these plants that repel, and in some cases, even kill some insects.

Traditional storage methods also play an important role in preserving the longevity of textiles. While only some of the actual storage container materials have insect repelling properties themselves (sandalwood, camphor wood), what they all have in common, whether earthenware or woven baskets, is ideal ventilation: little enough to keep the fabric from turning dry and brittle, and just enough to keep the fabric from retaining moisture and getting moldy, both of which are insect-attracting situations.

As we become more conscious of the harmful impacts on the planet, and the effects of chemicals on people's health, there is a proliferation of these plants on the market shelves. Scientific articles are being published regarding the effectiveness of some plants, while enthusiasts are publishing helpful DIY tutorials on social media. In Southeast Asia, more hotels are using citronella stalks and pandan leaves to deter mosquitoes and cockroaches in washrooms, and are hanging pouches of herbs and spices on clothes racks to deter termites, cockroaches and silverfish.

Some of the elders interviewed found these natural methods to be successful, if combined with good housekeeping, otherwise known as IPM. For example: keeping food away from collections, monitoring collections regularly, especially during the summer or wet season, help to mitigate unwanted pests. Regular and careful inspection can also detect mold or dead insects, or exhausted herbs, which themselves are insect attractants. These simple practices, if carried out regularly, are effective ways to deter and diminish pests and mold. These herbal remedies are not 'magic bullets', but combined with due diligence, they are part of a practical and safe conservation toolkit and easily applied to home use.

Endnote

1 Brunei Darussalam, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Timor-Leste, Vietnam.

Julia M. Brennan has worked in the field of textile conservation for over thirty years. Caring for Textiles, her company, was founded in 1996 and is based in Washington DC. She does a full range of textile treatments, display, installations, storage and survey work for institutions and private clients.
Julia's advocacy for preservation outreach has taken her back to Southeast Asia, a most beloved region, where she grew up. From 2000 to 2008, she led multiple textile preservation workshops in Bhutan and helped establish the National Textile Museum. Since 2008, she has been training a new generation of textile conservators in Thailand, at the Queen Sirikit Museum of Textiles in Bangkok, and leading preservation trainings in Indonesia, Taiwan, Rwanda and most recently Cambodia. Julia Brennan is a Professional Associate of the American Institute for Conservation and an active member of ICOM-CC Textiles Working Group, IIC, the Washington Conservation Guild, APTCCARN and Collections Care Network (CCN).

Linh Anh Moreau joined SEAMEO SPAFA as Documentation Officer in 2013 and became Programme Officer in 2015. She completed her BA and MA in Southeast Asian Studies at the School of Oriental and African Studies, University of London (SOAS), and a Master in Communication at the University of Paris Sorbonne Nouvelle where she also worked at the Student Affairs Office in developing student-led cultural projects. Prior to joining SEAMEO SPAFA, she was an Art Docent at the Asia Society Texas Center and gained work experience at various institutions including the UN and the French Research Centre on Contemporary Southeast Asia (IRASEC).

Contributors: Barbara Dailey and Archives Conservation Lab team, Archives and Research Library, Sri Aurobindo Ashram, Pondicherry, India. Benny Gratha, Freelance Textile Curator, Jakarta, Indonesia.

Forthcoming book: Brennan, J. and Moreau, L.A. (forthcoming) Our Ancestors Knew Best: Traditional Textile Treatments and their Place in Modern Conservation, Bangkok: SEAMEO SPAFA.
Research on alternatives to chemical cleaners and detergents for historic textiles stimulated the project. Information about pest control, storage, and traditional knowledge and beliefs became an equally important part of the findings. The compiled data is a first and unique resource, with valuable cross-referencing of each plant to a comprehensive plant database in the publication.
Register to receive your free copy at:
http://bit.ly/book_order_textile_preservation_in_SEA
(those who register will be invoiced for airmail postage and a 5% Paypal processing fee).

Bibliography

Agrawal, O.P. (1984) Conservation of Manuscripts and Paintings of South-east Asia, London: Butterworths, p. 276 (Appendix 2: Natural materials for preserving palm-leaf, Sweet Flag entry).

Brennan, J. and Moreau, L.A. (forthcoming) Our Ancestors Knew Best: Traditional Textile Treatments and their Place in Modern Conservation, Bangkok: SEAMEO SPAFA.
Jantan, I and Zaki ZM (1999) Development of environment-friendly insect repellents from the leaf oils of selected Malaysian plants. ASEAN Review of Biodiversity and Environmental Conservation November-December: 1-7.

Kossouoh, C, Moudachirou, M, Adjakidje, V, Chalchat, J-C and Figérédo, G (2005) Essential oil chemical composition of Annona muricata L. leaves from Benin. Journal of Essential Oil Research 19(4).

Li, J and Ho, SH (2003) Pandan leaves (Pandanus amaryllifolius Roxb.) as a natural cockroach repellent. Proceedings of the 9th National Undergraduate Research Opportunities Programme 13 September 2003.

Ludwiczuk, A, Skalicka-Wozniak, K, Georgiev, MI (2017) Chapter 11 – Terpenoids. In S Badal McCreath and R Delgoda (eds) Pharmacognosy: Fundamentals, Applications and Strategies. Tokyo: Academic Press, 233-266.

Mutalib, NA, Azis, TMF, Sarina Mohamed, Azizan, NI, Sidek, HJ, Roziana, MH and Razali, Z (2017) The Repellent and lethal effects of black pepper (Piper nigrum), chilli pepper (Capsicum annuum) and cinnamon (Cinnamomum zeylanicum) extracts towards the odorous house ant (Tapinoma sessile). Asian Research Publishing Network Journal of Engineering and Applied Sciences 12(8): 2710-2714.

Mwangi, EN, Hassanali, A, Essuman, S, Myandat, E, Moreka, L and Kimondo, M (1995) Repellent and acaricidal properties of Ocimum suave against Rhipicephalus appendiculatus ticks. Experimental and Applied Acarology 19(1): 11-18.

National Pesticide Information Center (13 November 2014) Mothballs. Available at http://npic.orst.edu/ingred/ptype/mothball/index.html (accessed 13 October 2019).

Orwa, C, Mutua, A, Kindt, R, Jamnadass, R and Anthony, S (2009) Syzygium aromaticum. Agroforestree Database: A tree reference and selection guide version 4.0. Available at http://www.worldagroforestry.org/treedb/AFTPDFS/Syzygium_aromaticum.PDF (accessed 11 May 2018).

Potera, C (2011) Innovative technologies: Tobacco bio-oil kills agricultural pests. Environmental Health Perspectives 119(1): A18.

Su, HCF (1978) Laboratory study on toxic effect of black pepper varieties to three species of stored-product insects. Journal of the Georgia Entomological Society 13(3): 269-274.

Trematerra, P and Sciarretta A (2002) Activity of chilli, Capsicum annuum L. var. Acuminatum, on stored product insects Oryzaephilus surinamensis (L.), Sitophilus oryzae (L.) and Tribolium castaneum (Herbst). Integrated Protection of Stored Products 25(3): 177-182.

Tripathi, AK, Upadhyay, S, Bhuiyan, M and Bhattacharya, PR (2009) A review on prospects of essential oils as biopesticide in insect-pest management. Journal of