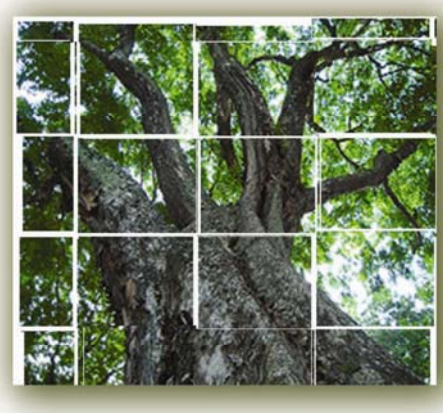
RESEARCH TECHNICAL NOTES
CUGE CENTRE FOR URBAN GREENERY AND ECOLOGY
A publication for landscape practitioners by the Centre for Urban Greenery & Ecology

FUNGISTATIC PROPERTIES OF ANGSANA EXUDATES

04/2010



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A collaborative team of researchers from NParks, the Agri-Food and Veterinary Authority (AVA), and Nanyang Technological University (NTU) has recently uncovered evidence of the prophylactic properties of angsana (Pterocarpus indicus) gum exudates. The red-colored gum, sometimes called a 'kino,' is typically exuded from the tree after being wounded.

The recent findings suggest the exudates may significantly limit fungal colonisation through chemical inhibition.

The fluid oozing from a tree wound is called an exudate, and this is a method of self-preservation unique to the plant kingdom. One characteristic difference between plants and animals is the inability of the former to move, and plants have evolved a number of strategies to cope with their fixed positions. Immobility allows plants to avoid burning up energy while hunting for food, but it also leaves them in a particularly compromising position unable to run away from threats.

As a result, plants produce an enormous range of defensive products offering protection in the face of an aggressive onslaught from herbivores, fungi, and bacteria.

In order to protect themselves, plants construct several physical and chemical defensive barriers against pest and diseases. Thorns, hairs, and tough tissues all act as physical barriers against herbivory by directly limiting ingestion. Chemical defenses, on the other hand, act in a variety of ways to ward off threats.

They include a wide range of compounds classified as alkaloids, phenolics, and terpenes; and these chemical products are uniquely different from other plant chemicals, such as chlorophyll and phytochrome, responsible for primary metabolism.

Van Hoven has discovered that the tree responds to the grazing by increasing the concentration of tannin in its leaves and the result is an unpalatable taste for the kudu. This particular chemical defense, along with other similar methods, affords self-protection in the face of plant pathogens and herbivores.

The production of exudates after injury is another common form of plant defense. Tropical trees frequently produce sticky gums, resins, or latex that flow from damaged plant parts. In this region, the production of gums is mainly limited to members of the Leguminosae family, while latex producing species are commonly members of the Apocynaceae, Sapotaceae, Moraceae, and Euphorbiaceae families (Boer and Ella, 2001; Turner, 2001).

These compounds can physically deter herbivores by filling up their mouthparts or covering their bodies; and they also limit infection by drying and hardening over a wound surface. In addition, the exudates may contain chemical compounds limiting infection by disease pathogens, including fungi and bacteria.

In addition to serving important roles in plant defense, exudates have been highly valued commodities throughout history. Regionally, the Brazilian rubber tree, Hevea brasiliensis, has played an important economic role in productive agricultural economies, and the species was first evaluated against other latex-producing species in Singapore Botanic Gardens in the late 1880's. The early 1900's witnessed an enormous expansion of rubber plantations throughout Southeast Asia (Hubner, 1934), and this plant exudate was used in the production of numerous goods, including rubber hoses and belts.

In the 1990's, Dr. Pim Sanderson and other NParks staff investigated the water solubility of angsana gum exudates, and learned that they were insoluble in water after being heated above 150°C. Many will relate to this chemical reaction through their wardrobe. The gum exudates are impossible to remove from clothing after being inadvertently heated with an iron, a regrettable experience shared by many.

Recent work in Singapore sheds additional light on the function of these exudates in angsana (Pterocarpus indicus). In the recent tests with angsana exudates, Dr. Mohd Ismail Mohd Ali and Dr. Wong Jia Yih, plant pathologists at AVA, evaluated the ability of angsana exudates to discourage fungal spore germination.

They combined the gum exudates with Trichoderma, a saprophytic ascomycete fungus commonly infecting dead organic matter, and monitored the fungal spore germination rate. In laboratory tests, they observed relatively low spore germination in liquid gum exudate dilutions ranging between 0 - 95%. Although the exudates were collected from a small number of samples, there appears to be considerable chemical inhibition of Trichoderma spore germination. Dr. Ali and Dr. Wong also noticed the fungal spores and hyphae acquired a brown discolouration, a common visual indication of antagonism.

What do these results mean for professional arborists? They should be interpreted carefully. Although we have uncovered evidence of the chemical fungal inhibition, the exudates may not successfully prevent angsana wound fungal infections in the landscape. In recent work, we focused on the effects of the exudates on one fungal species. We have discovered chemical inhibition against Trichoderma and this inhibition may not exist against other fungal species. Landscape conditions may also significantly affect the rate of wound infection. Small wounds inflicted upon vigorously growing trees will most likely have a greater proportion of the wound surface covered by the exudates compared to large injuries in trees suffering from stress. In the forest, trees have evolved mechanisms for coping with small wounds resulting from branch shedding and animal injury, but trees may not be well adapted to large pruning wounds. Additionally, wound pathogens may gain a considerable advantage under favorable environmental conditions or high inoculum potential.

Therefore, expectations of the exudates' prophylactic efficacy should be moderated by these considerations. However, these natural mechanisms for plant defense provide fascinating perspectives in tree management, and they may offer novel disease treatment opportunities if they can be fully understood. ■

PROJECT BACKGROUND INFORMATION

The work referenced in this technical note is part of a three-year collaborative CUGE Research arboriculture project. The project aims to improve the health of urban trees in Singapore using a method of biological control. Trichoderma, a saprophytic fungus prevalent in the soil and air, has recognised ability to limit the growth and activity of plant pathogenic fungi, and the ability of Trichoderma to control plant pathogens has been extensively studied and characterized in previous research work. In this project, a team of researchers from the National Parks Board, the Agri-Food & Veterinary Authority, and Nanyang Technological University will evaluate the potential of Trichoderma to control fungal pathogens on tree pruning wounds. The target species for the study are Khaya senegalensis and Samanea saman, and the intended outcome of the project will be a preventative liquid solution applied to pruning wounds after arboricultural pruning. If proven effective, this would serve as a biological control against fungal infection and improve the condition of Singapore's urban forest. Initially, Pterocarpus indicus was being considered for a target species in this study, and these test results indicate the angsana gum exudates may significantly limit Trichoderma germination. Therefore, the efficacy of a Trichoderma biological control treatment may be restricted on angsana.

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