INVASIVES

Newsletter of the Asia-Pacific Forest Invasive Species Network (APFISN)

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Recent books

- Eological Restoration: Principles, Values, and Structure of an Emerging Profession
- Ecology and Management of Giant Hogweed: *Heracleum mantegassiannum*
- Non-Chemical Weed Management: Principles, Concepts and Technology
- Invasive Forest Insects, Introduced Forest Trees, and Altered Ecosystems: Ecological Pest Management in Global Forests of a Changing World

Forthcoming Symposia/Workshops

- 5-7 February 2008. International Conference on Biofouling & Ballast Water Management, Goa, India
- 10-13 February 2008. Australian and New Zealand Biocontrol Conference, Sydney, Australia

The Asia-Pacific Forest Invasive Species Network (APFISN) has been established as a response to the immense costs and dangers posed by invasive species to the sustainable management of forests in the Asia-Pacific region. APFISN is a cooperative alliance of the 33 member countries in the Asia-Pacific Forestry Commission (APFC) - a statutory body of the Food and Agriculture Organization of the United Nations (FAO). The network focuses on inter-country cooperation that helps to detect, prevent, monitor, eradicate and/or control forest invasive species in the Asia-Pacific region. Specific objectives of the network are: 1) raise awareness of invasive species throughout the Asia-Pacific region; 2) define and develop organizational structures; 3) build capacity within member countries and 4) develop and share databases and information.

Leucaena leucocephala- twig with flowers

Pine pitch canker

INVASIVES, bimonthly newsletter of the Asia-Pacific Forest Invasive Species Network (AFPISN) is intended to share information among countries in the Asia-Pacific region on Forest Invasive Species(FIS) and the threats they pose in the region. If you have any items of news value on FIS to share between national focal points of APFISN and more widely among foresters, agriculturists, quarantine personnel and policy makers, please pass them on to the editor - Dr. K. V. Sankaran, APFISN Coordinator, Kerala Forest Research Institute, Peechi-680 653, Kerala , India (sankaran@kfri.org). The newsletter is supported by the Food and Agriculture Organization of the United Nations (FAO) and USDA Forest Service.

Leucaena leucocephala

Leucaena leucocephala (Lam.) de Wit., a leguminous evergreen shrub/small tree, is a conflict species because although it is planted widely for reforestation and forage production, it can spread naturally as a weed wherever it has been introduced. The tree can form dense monospecific thickets which can replace native forests. It is difficult to eradicate Leucaena once established, and it can convert large areas into unusable and inaccessible zones. The tree is reported as a weed in more than 20 countries across all continents except Europe and Antarctica. It spreads naturally and threatens endemic species of conservation concern in several regions. In the past, Leucaena was known as a miracle tree because of its worldwide success as a long-lived and highly nutritious forage tree and its use as fuelwood, charcoal, pulpwood and soil improver. Native throughout the West Indies from the Bahamas and Cuba to Trinidad and Tobago, and from southern Mexico to northern South America, the fodder value of the tree was recognized over 400 years ago. In the sixteenth century, the Spanish carried Leucaena feed and seed to the Philippines to feed their livestock. Currently, the tree is spread far and wide in the Asia-Pacific region, where it was introduced as an agroforestry crop.Leucaena was introduced into Australia in the late nineteenth century and it was firmly established by 1920. The allelopathic effect of the tree inhibits the germination and growth of other trees.

Leucaena infestation

Leucaena is an arborescent deciduous small tree that reaches up to 20 m tall, is fast- growing and has a trunk 10 - 25 cm in diameter. It forms dense stands if crowded; slender trunks are formed with short bushy tufts at the crown and spreading if singly grown. Leaves are evergreen, alternate, 10 - 25 cm long, malodorous when crushed, bipinnate with 3-10 pairs of pinnae, each with 10 - 20 pairs of sessile, narrowly oblong to lanceolate, gray green leaflets 1 - 2 cm long and less than 0.3 cm wide. Flowers are numerous, axillary on long stalks, white, in dense global heads 1 - 2 cm across. Fruit pods have a raised border, are flat, thin, becoming dark brown and hard, 10 - 15 cm long, 1.6 - 2.5 cm wide, and dehiscent at both sutures. Seeds are copiously produced (15-30 per pod), oval, flattish, shiny brown in color, numbering 18,000 - 24,000 per kg. Seeds remain viable for 3 to 4 years. The germination rate of the seeds varies from 5% to 90%. Flowering starts within a year of germination and after two years the tree produces fruits all year round. The tree is deep-rooted, nitrogen-fixing and moderately shade tolerant.

Leucaena - flower

Leucaena tolerates a variety of soil conditions, but the best growth is obtained on deep and fertile soils. The tree grows as a weed in agricultural areas, coastlands, natural forests, planted forests, range/grasslands, riparian zones, disturbed land, scrub/shrublands, urban areas and also along roadsides. It can withstand slightly alkaline and saline soils and soils low in phosphorus and iron. Leucaena coppices readily and is resistant to drought and fire. It can grow in sub-humid climates with up to 3,000 mm annual rainfall and can also tolerate up to seven months of dry weather. Optimum growth of the tree occurs at 25-30° C. The tree is not frost-hardy and grows poorly, producing less seeds, in cooler tropical highland sites. Leucaena is highly palatable to most grazing animals when compared to other forage tree legumes, but the leaf and seed contains mimosine, a non-protein amino acid which has antimitotic and depilatory effects on animals. Utilization of the tree for forage purposes, food, fuel and medicine is a good management method. In Queensland, Australia, management practices aimed at minimizing the risk of Leucaena's spread and invasion are being promoted under a code of good practice for livestock farmers who cultivate Leucaena.

Leucaena - fruit

There is a clear conflict of interest between the agro-forestry value of the tree and its deleterious environmental impact. As a weed, several methods are used for controlling Leucaena. A mechanical method involves the removal of trees by hand or using machines. Cutting or burning of Leucaena is also practiced. Both methods are seldom successful since the tree can coppice easily and can re-grow from burnt stumps by generating basal shoots. In chemical methods, post-emergence herbicides such as Bentazone and Imazethapyr are commonly used in Australia. Basal bark application of herbicides containing 120 g/l Picloram and 240 g/l Triclopyr mixed with diesel is practiced in some countries. Application of Glyphosate to re-growth after slashing will kill trees, but repeated applications may be necessary for long-term control. A psyllid viz., *Heteropsylla cubana*, causes serious damage to Leucaena in the islands of Java. This psyllid feeds on the young shoots of Leucaena, resulting in the loss of leaves. In Queensland, the psyllid reduced the production of

Seeds of Leucaena

edible material by 52%. A bruchid beetle seed predator, *Acanthoscelides macrophthalmus*, was introduced and released in South Africa as a biocontrol agent of Leucaena.

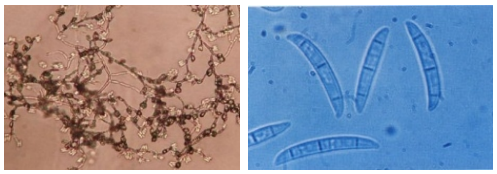
Pine pitch canker (*Fusarium circinatum*)

Pine pitch canker is a disease of conifers caused by the fungus *Fusarium circinatum* (*Fusarium subglutinans* f.sp. *pini*). It is a serious problem in the USA and can cause major damage to plantations. *Pinus radiata* and fir trees (*Abies* spp.) are highly susceptible to this disease. Its occurrence on *Pinus radiata* was first recorded in 1986 in California. Since then, it has become widespread in most parts of the southeastern USA. Since 1986, pitch canker has also been reported in Mexico, Haiti, Japan, Chile, South Africa and Spain. Australia is now free from this disease, but the risk of reinfestation remains. In the 1990s, the pathogen was reported to induce a root rot among containerized *Pinus patula* seedlings in South Africa. It is known to affect several species of pine, including *P. canariensis*, *P. elliottii*, *P. echinata*, *P. halepensis*, *P. rigida*, *P. palustris*, *P. ponderosa*, *P. pungens*, *P. strobus*, *P. taeda* and has made a transgeneric jump to Douglas fir (*Pseudotsuga menziesii*). In northern Florida, the disease has spread sporadically and caused varying amounts of damage.

Pine plantation affected by pine pitch canker disease

Pines are planted over vast areas throughout Australia and New Zealand and are the basis of a major industry. The pitch canker fungus causes severe damage and losses to both pine plantations and amenity plantings, especially in drought-affected areas. In the USA, losses from tree mortality, reduced timber quality, reduced growth and seed contamination have been extensive.

Colonies of the fungus on potato-dextrose agar show distinct margins; the aerial mycelium is almost white, hairy to lanose-funiculose. Pigmentation in reverse is greyish white to grey to dark violet at the center of the colony. Conidia are aggregated in false heads; sporodochia are produced after 2-3 wks at 20°C. Conidiophores arising from the aerial mycelium are erect and strongly branched, with branches terminating mostly in 12 phialides, often proliferating and associated with coiled sterile hyphae, which are diagnostic for this species. Sporodochial conidiophores are verticillately branched. Phialides of theaerial conidiophores are cylindrical, mono and polyphialidic, up to 30 x 3 µm. Conidia borne on the aerial mycelium are mostly obovoid, occasionally oval to allantoid, and mostly aseptate, 8.5 - 10.9 x 2.8 - 3.6 µm. Conidia borne in sporodochia are slender, cylindrical and mostly 3 septate, 33.7 - 42.7 x 3.4 - 3.7 µm. Chlamydospores are absent. The perithecia of *F. circinatum* is ovoidal to obpyriform, 230 µm wide, non-papillate, solitary, dark purple in water and 3% KOH, becoming red in 100% lactic acid. Asci are cylindrical, 88 - 100 x 7.5 - 8.5 µm, apex has a shallow, refractive ring. Ascospores are ellipsoidal to fusiform, smooth, hyaline, septate, mostly 11.1 - 14 x 4.7 - 5.5 µm, with additional septa developing after discharge.



Conidial aggregation and macroconidia of *F.circinatum*

The fungus is a wound pathogen. Naturally occurring wounds made by animals, wind stress, branch removal and other mechanical damage can all provide entry sites for spores. The eastern pine weevil, which breeds in dying trees and feeds on the phloem of young branches, can transmit the disease. The airborne spores are spread by wind, rain splash and also by insects. Spores are abundant in the litter beneath diseased stands, and fruiting bodies persist for months on diseased shoots. The spores sometimes act as a root pathogen and are also found in seeds as well as seed coats. The fungus is able to survive for more than 12 months in logs and in resin impregnated tissues.

Damage to pine seedlings

The first symptoms of pine-pitch canker include yellowing of the needles, wilting and dieback of branch tips. The needles then turn red and drop from the tree. Cankers may appear on the main branches or trunk. Removal of bark from an infected area reveals slightly sunken, honey-colored wood that is soaked with resin. Resin is exuded from these cankers, often in copious quantities. This resin, or pitch as it is called in the USA, may coat the trunk for several meters below the infection. Infection can occur on branches, shoots, cones, exposed roots and stems. Infected seedlings may develop root rot. Stem cankers are flat or slightly sunken and may be up to 30 cm in diameter. The cankers usually appear following the incidence of stem/branch dieback, stem deformity, and reduced growth of the tree. Female cones abort

Infection on pine trunk

before or after reaching full size, and remain closed on infected whorls. Trees with advanced symptoms of the disease have significant crown dieback due to the large number of infected branch tips. The symptoms are often accompanied by the death of twigs, tree tops and entire trees due to the pathogen and/or bark beetle attack. The symptoms of pitch canker may appear at any time of the year, but most new symptoms have been observed during spring and early autumn.

The pathogen is associated with numerous insects. The main vectors are *Ips paraconfusus*, *I. mexicanus*, *Conophthorus radiata* and *Ernobius punctulatus*. Species such as *Pityophthorus nitidulus*, *P.setosus*, *P.carmel* and *Ips plastographus* are also suspected to be vectors, as fungus spores are often found associated with them. Seed transmission has now been demonstrated in Pinus radiata and is the main pathway through which pitch canker can be transmitted over long distances and introduced into new areas.

No effective fungicides or biological control agents are available. Debarking recently killed trees and branches, timely chipping and removal of diseased or insect infested tree material from nearby susceptible trees are some of the methods used to check the spread of the disease. The disposal of diseased material is the most important method to avoid spread of the disease to uninfested areas. Any material that is removed from the site should be tightly covered with a tarp during transit and taken to the nearest landfill or designated disposal facility for prompt burial, composting or burning. Disinfection of pruning tools, restrictions on the movement of wood (logs, chips, waste wood, firewood) and on the movement of trees such as *Pinus radiata* will also help check the spread of the disease. The use of resistant trees may be possible in the future, as recent experiments have shown that resistance may be present in some *Pinus radiata* trees.

Resin exudation due to infection

News column

Global compendium of weeds

The Global compendium of weeds (GCW) is a list of plant species (over 28,000 names) that have been cited in specific references (approximately 1,000) as weeds. An expert has assessed the status of each weed based on its context in each document. Additional information such as native range, whether the plant has reported medical/herbal uses, etc. are also included if available.

The inclusion of a species in the GCW does not necessarily indicate that the GCW author or sponsors (or the sponsors of the hosting website) consider the species to be a weed, nor do those entities vouch for the veracity of any particular source. The GCW is simply an attempt to provide summary information from a wide range of documented sources. If you can suggest corrections, recommend additional source documents, or require further information about the GCW, please contact gcw@hear.org. This website is a collaborative venture between AgWest (data & weed expertise) and the Hawaiian Ecosystems at the Risk project (HEAR) (database consultation & website management).

Biocontrol of invasive water hyacinth contributes to socioeconomic and health improvements in Africa.

In research results that were presented at the annual meeting of the American Society of Plant Biologists (ASPB) in Chicago on July 7-11, 2007, scientists reported a successful bioeradication program of water hyacinth in Africa's Lake Victoria. Two insect biocontrol species, weevils in the genus *Neochetina*, were used, along with mechanical removal, to control the highly invasive weed which has also plagued waterways in the southern United States. This method of water hyacinth biocontrol, originally researched and implemented in Florida in the 1970s, eliminates or drastically reduces the use of pesticides. In the Lake Victoria region, water hyacinth threatened the livelihoods of local communities by reducing fish populations, fouling hydroelectric power turbines and providing habitats for malaria vectors. Similar biocontrol programs have been successfully applied throughout the tropics and subtropics.

Potential use of Kudzu as a biofuel

Recently, tremendous effort has been put forth to identify plants having the potential to be used as bio-fuels. Kudzu (*Pueraria montana* var. *lobata*), while native to Asia, has proliferated as an invasive weed throughout the southern U.S. It is currently at or near the top of invasive species lists for virtually every southern state in the U.S. Kudzu is a nitrogen fixer and, thus, grows rapidly across the landscape with no inputs. Given its perennial growth habit, its rapid growth rate, and the fact

that it has high starch content (particularly the root system), its potential as a biofuel could be tremendous. However, to date, this potential has gone unstudied. This is now being investigated by scientists in the USA. To begin with, the above- and below-ground biomass production and associated starch and nutrient content will be determined. This initial work may lead to more in-depth studies of potential kudzu production systems, harvesting techniques, and cost/benefit analyses.

New publications

Reaser, J.K., Meyerson, L.A., Cronk Q., De Poorter, M., Eldrege, L.G., Green, E., Kairo, M., Latasi, P., Mack, R.N., Mauremootoo, J., O'Dowd, D., Orapa, W., Sastroutomo, S., Saunders, A., Shine, C., Thrainsson, S. and L. Vaiutu. 2007. Ecological and socioeconomic impacts of invasive alien species in island ecosystems. Environmental Conservation, 34:98-111.

A. M.Rask and P. Kristoffersen. 2007. A review of non-chemical weed control on hard surfaces. Weed Research, 47: 370-380.

Baker J., Hidayat I. and C. Preston. 2007. Molecular tools for understanding distribution and spread of weed genotypes. Crop Protection, 26: 198-205.

Bebawi, F.F., Lockett, C.J., Davis, K.M. and B.V. Lukitsch. 2007. Damage potential of an introduced biological control agent *Agonosoma trilineatum* (F.) on bellyache bush (*Jatropha gossypiifolia* L.). Biological Control, 41: 415-422.

Julien, M.H., Scott, J.K., Orapa, W. and Q. Paynter. 2007. History, opportunities and challenges for biological control in Australia, New Zealand and the Pacific Islands. Crop Protection, 26: 255-265.

Sinden, J.A. and G. Griffith. 2007. Combining ecological and economic arguments to value the environmental gains from control of 35 weeds in Australia. Ecological Economics, 61: 396- 408.

Taylor, D.B.J., Heard, T.A., Paynter, Q. and H. Spafford-Jacob. 2007. Non-target impact of a weed biological control agent on a native plant in northern Australia. Biological Control, 42: 25-33.

Recent Books

Eological Restoration: Principles, Values, and Structure of an Emerging Profession. By Andre F. Clewell and James Aronson, Published by Island Press 2007. This book offers for the first time a unified vision of ecological restoration as a field of study, one that clearly states the discipline's precepts and emphasizes issues of importance to those involved at all levels. The authors discuss scientific and practical aspects of the field, as well as the human needs and values that motivate practitioners. The book identifies fundamental concepts upon which restoration is based. A unique feature of the book is the inclusion of eight "virtual field trips," short photo essays of project sites around the world that illustrate various points made in the book, led by those who were intimately involved with the project described. Throughout, ecological restoration is conceived as a holistic endeavor, one that addresses issues of ecological degradation, biodiversity loss, and sustainability science simultaneously, and draws upon cultural resources and local skills and knowledge in restoration work.

Ecology and Management of Giant Hogweed: *Heracleum mantegassiannum.* By P Pysek, M Cock, W Nentwig and H. Ravn,OxfordUniversityPress, 2007. The giant hogweed, *Heracleum mantegazzianum*, is a pernicious invasive species, with significant impact on human health due to its toxic sap. From its native area, the Caucasus, it has spread across Europe, creating serious environmental and health problems. This book, the output of a three-year EU project involving 40 European experts, is an authoritative compendium of current knowledge on this amazing invasive plant and will facilitate improved management. It is an invaluable resource for both practitioner and student, and covers topics including taxonomy, genetics, reproduction, population ecology, and invasion dynamics. It also reviews the possibilities of mechanical, chemical and biological control.

Non-Chemical Weed Management: Principles, Concepts and Technology. By M.K Upadhyaya and R. E. Blackshaw, Published by CABI Publishing, 2007. Following several decades of popularity after the Second World War, the use of synthetic herbicides is now experiencing a backlash within the agriculture industry. The increase in organic farming and concerns about potential negative effects on human health and the environment is creating a demand for pesticide-free food and alternative weed management techniques. International research has now explored the potential, limitations and impacts of non-chemical alternatives and the effect of different strategies on the entire agro- or natural ecosystem. Through the re-evaluation of techniques previously considered uneconomical or impractical, this text provides a comprehensive examination of non-chemical weed management.

Invasive Forest Insects, Introduced Forest Trees, and Altered Ecosystems: Ecological Pest Management in Global Forests of a Changing World. By Paine, Timothy D, Published by Springer, 2007. Demand for timber and fibre continues to grow and is being met by increased reliance on plantation forestry. Many of the plantations that are being grown around the globe are non-native species that have characteristics of rapid growth and good commercial qualities. In some cases, the high rates of production are due to the absence of native herbivores and diseases. This limited pest status is threatened as pest species move around the globe. At the same time, there is concern about threats of these non-native plantation species on native communities and the impact of changing climates on forest productivity. This volume explores many of these issues for the first time.

Forthcoming Symposia / Workshops

5-7 February 2008. International Conference on Biofouling & Ballast Water Management, Goa, India. Many organisms with a sessile or sedentary mode of life have the dual distinction of being important in hard substratum ecology and a biofouling problem in the marine environment. Their colonization on man-made structures also aids in their dispersion into alien environments, often with devastating consequences; the hulls of ships are a major vector in such dispersion. Likewise, the introduction of harmful aquatic organisms into new environments via ballast water in ships has also been identified as one of the four greatest threats to the health of the world's oceans. The International Conference on Biofouling and Ballast Water Management aims to address these urgent issues synergistically with the goal of recognizing common problems and the development of new solutions. The main themes are: 1) biofilms and bioadhesion; 2) biofouling community; 3) larval biology; 4) antifouling technology; 5) marine bioinvasion; and 6) ballast water management/treatment technology. Contact: Dr. A.C. Anil (icbab@nio.org)

10-13 February 2008. Australian and New Zealand Biocontrol Conference, Sydney, Australia. The conference will span the disciplines of insect pests, weeds, plant pathogens and vertebrate pest biological control and there will be numerous sessions dedicated to aspects of each. Sessions and keynote presentations will include international speakers that will discuss biocontrol success stories, eradication of emergency plant pests with the use of biocontrol agents, ecological control of insects, vertebrate pest control, biocontrol safety, the way forward for Australasia and many more topics. There will be ample opportunity for workshops; break-out sessions and there will be a poster display available for the duration of the conference. Contact: Dr Leigh Pilkington, leigh.pilkington@dpi.nsw.go.v.au

Compiled and edited by Dr. K. V. Sankaran, APFISN Co-ordinator on behalf of the Asia-Pacific Forest Invasive Species Network. For more information on the APFISN, please contact your national focal point or the APFISN Co-ordinator or Mr. Patrick Durst, Senior Forestry Officer, FAO Regional Office for Asia and the Pacific, 39 Phra Atit Road, Bangkok. Email: patrick.durst@fao.org