

V. altissima. The percentage of survival from larvae to pupa and from pupa to adult was also slightly lower in insects reared on *V. altissima*.

The present study shows that *V. altissima* can support populations of teak defoliator under natural conditions. However, shorter larval and pupal periods, greater pupal weight and high survival percentage of *Hyblaea* on teak show that *T. grandis* is a better host plant than that of *V. altissima*. This is the first report of *V. altissima* as a host plant of the teak defoliator, *H. puera*.

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ANTAGONISTIC EFFECTS OF PHYLLOPLANE MICRO-ORGANISMS AGAINST *CERCOSPORA MORICOLA* COOKE

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STUDIES on the antagonistic relationships of phylloplane micro-organisms against foliar pathogens have received much attention from the point of view of biological control. Many attempts have been made in recent years for isolating and evaluating microbes inhibitory to plant pathogens¹. *Cercospora moricola* causes severe leaf spot disease of mulberry (*Morus indica* L), the chief source of food for silkworms². Use of fungicides to control the disease results in extreme residual toxicity to the silkworms. Under such conditions biological control of the disease using leaf surface antagonists is highly beneficial. The present study reports the screening of such antagonists isolated from mulberry leaves against *C. moricola* both *in vitro* and *in vivo* conditions.

In vitro screening was conducted by germinating the pathogenic conidia in cell-free culture filtrate of

the test organism grown in 50 ml potato dextrose broth (PDB) for 15 days. Data on the germination and post-germination development of the conidia were collected after 24 hr of incubation. PDB used in place of culture filtrate served as control. *In vivo* studies were conducted by inoculating the leaves simultaneously with the pathogenic conidia and the test organism, harvested from a seven-day-old culture grown on PDB. Plants receiving pathogenic conidia alone served as control. The treated plants were incubated under high humidity overnight and the data were collected on the 10th day after inoculation. Triplicates were maintained for each treatment and the percentage inhibition was calculated using the formula of Heuvel³.

A total of 14 types of micro-organisms were screened (table 1). Based on the percentage inhibition of spore germination, the antagonists were classified into low (1–25%), moderate (26–50%) and strong (51–100%) inhibitors. *Sporobolomyces roseus*, *Drechslera sorokiniana*, *Chaetomium globosum*, *Pullularia pullulans*, *Cryptococcus laurentii* and *Tilletiopsis minor* exerted low inhibition. *Nigrospora sphaerica* and *Trichoderma viride* were moderate inhibitors while *Cladosporium cladosporioides*, *Staphylococcus* sp, *Corynebacterium* sp, *Curvularia lunata*, *Pseudomonas maltophilia* and *M. leucotrichum* behaved as strong inhibitors. The number of germ tubes produced and the length of germ tubes did not show any correlation with the degree of inhibition of spore germination.

The majority of the organisms tested under *in vivo* conditions retained their inhibitory activity in an increased proportion except *Corynebacterium* sp, *Staphylococcus* sp and *Trichoderma viride* which showed reduced inhibition compared to their behaviour under *in vitro* conditions. *M. leucotrichum*, though it completely inhibited leaf spot development, behaved as a pathogen when inoculated in sufficient concentration indicating the danger of its use as a biocontrol agent. However, significant reduction in the number of leaf spots was observed on the leaves receiving *P. maltophilia*, *C. cladosporioides* and *C. lunata* while the rest of the organisms showed moderate to low inhibition.

Use of antagonistic action is currently one of the most important resources of biocontrol and a number of microbes have been used to control plant diseases⁴. Direct parasitism, production of antibiotics and other substances, competition for nutrients on the host and stimulation of host defences are stated to be the chief mechanisms of antagonism⁵.

Table 1 Inhibitory effects of phylloplane micro-organisms on conidial germination and leaf spot development by *Cercospora moricola*

Test organism	Spore* germination	Percentage inhibition		
		no. of* germ tubes	length of* germ tube (μm)	number of** leaf spots developed
<i>S. roseus</i>	2.1	33.2	32.5	9.7
<i>D. sorokiniana</i>	2.1	24.4	25.4	25.3
<i>C. globosum</i>	5.2	35.8	46.0	5.8
<i>P. pullulans</i>	16.7	12.2	16.7	19.8
<i>C. laurentii</i>	21.9	43.3	80.2	30.4
<i>T. minor</i>	21.9	42.8	57.1	33.6
<i>N. sphaerica</i>	32.3	43.9	78.6	43.7
<i>T. viride</i>	49.0	32.1	41.3	29.9
<i>C. cladosporioides</i>	51.0	61.0	50.0	61.0
<i>Staphylococcus</i> sp	59.4	62.0	50.0	21.6
<i>Corynebacterium</i> sp	67.7	73.8	62.7	26.2
<i>C. lunata</i>	68.8	73.8	41.3	69.0
<i>P. maltophila</i>	68.8	75.0	53.2	80.3
<i>M. leucotrichum</i>	100.0	100.0	100.0	100.0
Control	0	0	0	0

*Based on 400 conidia *in vitro*; **Based on 50 plants *in vivo*

Out of the 14 antagonists tested in the present study, *P. maltophila*, *C. cladosporioides* and *C. lunata* have shown the potentialities to be used as biocontrol agents against *Cercospora moricola*. Detailed studies under field conditions are in progress.

Our sincere thanks are due to CSIR, New Delhi for financial assistance.

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NEWS

INDO-BRITISH ENVIRONMENTAL RESEARCH PROGRAMME

An Indo-British conservation initiative aimed at protecting animal and plant life in the face of development has been formally launched in Britain.

Three bodies—Britain's Royal Society for the Protection of Birds (RSPB), the British Nature Conservancy Council, and the Bombay Natural History Society—recently signed an agreement at the RSPB headquarters at Sandy, Bedfordshire, to collaborate on a series of projects.

The Indo-British Environmental Research Prog-

ramme will last for at least three years. The three organisations will examine the impact of afforestation, grazing and major construction works on flora and fauna. The implications of using pesticides, herbicides and fertilisers will be researched, and attention will be given to specific areas noted for their wildlife, such as Bharatpur. (British Information Services, British High Commission, Chanakya-puri, New Delhi 110 021).

NUCLEAR POWER IS OF SIGNIFICANCE FOR INDUSTRIAL COMPETITIVENESS*

Dr Hans Blix, Director General, International Atomic Energy Agency (IAEA), has expressed the conviction that nuclear power will survive the present post-Chernobyl crisis and will expand again after a few years if the safety and waste issues are satisfactorily managed.

In a speech to the Royal Institute of International Affairs in London, Dr Blix said: "Governments, who have the responsibility to keep their industries running and to raise the standard of living of their populations, need to provide increasing quantities of electricity at the lowest possible prices. All indications are that—despite conservation—electricity demand will continue to increase. The use or non-use of nuclear power to meet this demand has significance for a country's industrial competitiveness. In the far east, Japan, Korea and Taiwan are fast expanding their nuclear electricity production as a basis for their industrial growth and competitiveness. For western states to forego it would be a serious matter. France today enjoys among the lowest electricity prices for industry. If nuclear power were scrapped and coal used instead, it would require an entire US coal production of today's size to generate this electricity. If oil were to be used it would call for the oil production again of a Saudi Arabia in 1982."

Dr Blix pointed out that with Chernobyl nuclear safety has taken on a much stronger international dimension than before. With the fall-out far away from Chernobyl, he said, it was realized for the first time in a very concrete way that a nuclear cloud does not respect national borders. This, he said, showed the need for emergency assistance to bring accidents under control and contain their effects. "There must be binding rules about reactor safety everywhere to ensure that large-scale accidents of this kind do not occur again and there must be international verification that such rules are respected. The IAEA has a central role to play in this and has already covered a first part of the agenda with considerable results," he added.

Elaborating further on international measures, Dr Blix reported that the IAEA is now co-operating with the WHO and the FAO to harmonize national provisions about the levels of radioactivity at which milk and other foodstuffs should be deemed unwholesome. "Another measure is to be taken together with the WMO and consists in the creation of a possible system of continuous reporting of radioactivity levels around the world. A third new venture is likely to consist in efforts to work out a new convention on liability between states for accidents causing transboundary damage" he said.

The IAEA Director General underlined that the nuclear safety standards (NUSS), which deal with a wide range of safety related matters from the siting and design of power reactors to their operation are being examined to what extent they could get greater strength. He also pointed to the operational safety review teams (OSARTS) which have been sent to a number of facilities around the world to give governments an independent outside check on the safety of installations under their responsibility. He also admitted the need to strengthen international measures regarding the training programmes of operators.

As his answer to voices calling for the shut-down of all nuclear power plants, Dr Blix stressed that even if all nuclear power reactors in the world were scrapped, the unclear bombs would remain. "The scientific and technical features of bombs are now sufficiently well known to enable probably any country with sufficient infrastructure and resources to make a bomb, if it is determined to do so" he said. In this respect, Dr Blix said, the IAEA safeguards system could create a maximum of confidence among neighbouring states in the world at large that their nuclear programmes are in fact employed only for peaceful purposes. This system, he added, could also serve as a model to be used for the vital verification needed in some types of nuclear disarmament schemes. (PR 86/50, IAEA Division of Public Information, International Atomic Energy Agency, Wagramerstrasse 5, P. O. Box 100, A-1400 Vienna, Austria).

* Speech by Dr Hans Blix, Director General, International Atomic Energy Agency, The Royal Institute of International Affairs, London on 26 November 1986.

Full text of Dr Blix's speech is available in the Division of Public Information, IAEA, Vienna.

HALLEY'S COMET: NEW DISCOVERIES

Observations made by the Giotto spacecraft which so spectacularly intercepted Halley's Comet in March this year were a major subject of discussion at the recent Heidelberg symposium on the Exploration of Halley's Comet.

The week-long symposium, organised by the European Space Agency, attracted over 500 participants and 370 papers were presented by scientists from all over the world; covering the data from the six spacecraft which travelled to Halley's Comet—Giotto, Vega 1 and Vega 2, Suisei, Sakigake and ICE.

The results from the symposium confirmed many existing theories held by scientists, but they were astonished by the size, complexity and the tremendous influence Halley's Comet had upon vast areas of space. Interpretation of the wealth of data will continue for a long time, but studies now confirm the widely held belief that comets are ancient relics consisting of pristine material virtually unchanged since the formation of the solar system 4,500 to 5,000 million years ago.

The central nucleus of Halley's Comet, the source of all cometary material, was revealed for the first time by the Soviet Vega 1 and Vega 2 spacecraft and soon after by Giotto. Giotto undertook the most hazardous mission of all, passing within 378 miles of the heart of the comet taking dramatic close-up photographs. These show a potato-shaped nucleus measuring 10 miles \times 5 miles \times 4½ miles. It was

suggested that this irregular shape is the result of several small cometary objects having collided and joined together.

The nucleus as a body is extremely porous, with a density many times less than that of water. At the time of encounter, the surface temperature—due to the proximity of the sun—could have been as high as 100 degrees centigrade. The pictures from Giotto clearly show a number of active areas on the surface which continually ejected many tonnes of gas and dust into space.

Analysis of the gas and dust in the head of the comet also showed that the central nucleus is a large "snowball" of interstellar dust and grains of ice.

The comet's characteristic head and tail is formed by dust and gas; and in sweeping through this cloud, Giotto's instrumentation measured the chemical composition, size and abundance of dust grains and the comet's extensive atmosphere of electrically charged particles.

Analysis now reveals that the most plentiful elements in the comet are carbon, hydrogen, oxygen and nitrogen, which are present in many complex forms. There is considerable evidence that Halley's Comet is mainly water (80 per cent), with poisonous carbon monoxide being the next most abundant. (*British Information Services*, B 595, British High Commission, Chanakyapuri, New Delhi 110 021.)

APPROPRIATE TECHNOLOGY — APPROPRIATELY USED

One of the main problems is not the lack of appropriate technology, it is the lack of appropriate application of that technology. Even when the will exists to apply it, the best ways of doing so are often not so obvious. That is where health systems research comes in. . . . It is well to remind ourselves that the only apparatus needed for this kind of research is available in abundance but it is insufficiently used. I am referring of course to the human brain and its capacity for inquisitiveness, imagination, analysis and judgement. These capacities need sharpening—not easy, but not impossible; the first

step is to help people liberate themselves from the mud of mysticism engulfing health systems research and enable them to try, and possibly falter, and try again, and again, until they succeed.—Halldan Mahler, Director-General of WHO. Address to the Thirty-ninth World Health Assembly. WHO Chronicle, Vol. 40, No. 3 (1986). (World Health Forum, An International Journal of Health Development, 1986, Vol. 7, No. 2, p. 153; WHO Regional Office for South East Asia, World Health House, Indraprastha Estate, Mahatma Gandhi Road, New Delhi 110 002).

THIRD WORLD ACADEMY OF SCIENCES, ITALY

a) Physics Prize:

Prof. E. C. G. Sudarshan, Director, Institute of Mathematical Sciences, Madras has been awarded the 1985 physics prize by the Third World Academy of Sciences.

The award, in recognition of Prof. Sudarshan's fundamental contributions to the understanding of the weak nuclear force and particularly for his role in the formulation of the 'universal V-A theory', carries a cash award of \$10,000.

The prize, the first to be awarded by the Academy, was given to Prof. Sudarshan at a ceremony at Trieste headquarters in the International Centre for Theoretical Physics in Trieste, Italy on October 26.

Prof. Sudarshan is a Fellow of the Indian Academy of Sciences, Bangalore and takes interest in the activities of *Current Science*.

b) Other awards of the Third World Academy of Sciences:

Three other third world scientists receiving the Third World Academy of Sciences Awards of this year are the 89-year-old Prof. Salimuzzaman Siddiqui of Pakistan for his contributions in the Chemistry of rauwolfia alkaloids. Prof. M. M. Lian Shan Tao of China for his contributions in two different areas of Mathematics. Prof. Leopoldo De Meis of Brazil for his studies concerning their contributions in the Mechanism of energy transfer in biological membranes.

THE DEVELOPMENT OF "RADAR TAXONOMY"

The need to monitor airborne insect density and provide up-to-the-minute information on movements of insects of agricultural importance has led to the development of a fully automatic remote-sensing system which uses radar to detect and identify individual insect targets.

The radar, produced at Rothamsted Experimental Station at Harpenden, near London, comprises a short pulse-length transmitter coupled alternatively to one of two parabolic antenna systems. The antenna assemblies are driven by a computer to produce vertically directed, conically scanned beams within which the electric polarisation of the transmitted pulse can be rotated.

As insects fly through the radar beams at heights between 12.5 and 250 metres, the return echoes are detected and processed in real time using a high-speed, multi-processor computer. From measurements of the amplitude and phase of the return echo, the computer calculates the target insects' velocity, height of flight, body weight, shape and orientation. These data are then stored for subsequent transmission over the telephone to a remote central computer.

Ultimately the success of the system will depend upon the degree to which the target signatures can be classified as specific to insect types. This is a new subject area which is termed "radar taxonomy". The key to identification is the accurate measurement of the microwave scattering properties of the various insect species likely to be detected by the radar. Preliminary laboratory measurements have already been made on a number of insect species, the results agreeing with theoretical predictions.

Over the next few years, several fully automatic, computer-controlled insect radars will be operated at selected sites in the U.K. The resulting information on insect numbers and movement will be transferred immediately to Rothamsted, where it will be collated with the latest suction trap and field sampling data and used to provide day-to-day pest warnings and longer-term forecasts. (*Spectrum* — British Science News, No. 198, p. 22, 1986, British Information Services, British High Commission, New Delhi 110 021.)