

Science Last Fortnight

Downy Mildew in Maize Detecting pathogens in seeds

Maize is the third most important cereal crop in India. However, the crop is often infected by downy mildew. This disease affects growth and, consequently, production.

The pathogen involved, *Peronosclerospora sorghi*, reproduces both sexually and asexually. It survives as oospore in soils and infects seedlings. It is also dispersed as airborne conidia, an asexual, non-motile spore, which infects seeds. When infected seeds are sown in a plot, the pathogen spreads. To prevent the spread of the disease to other plots, it is important to detect the pathogen in seeds. Existing tests for the pathogen require expertise, time and costs.

Sireesha and Velazhahan from the Tamil Nadu Agricultural University now report a simple, rapid and reliable technique to detect the pathogen. The team collected 20 isolates of *P. sorghi* from sorghum and maize and extracted DNA from each. Then they randomly amplified polymorphic DNA markers. They identified a reproducible and prominent band from the genomic DNA in all the strains of the pathogen. Next, they identified a Sequence Characterized Amplified Region – a nucleotide sequence that can serve as a marker for the pathogen. Thus, they identified a 305 base pair DNA, unique to the pathogen.

To test this marker, they collected seed samples of 28 downy mildew infected field grown maize plants from different parts of India. The researchers also selected 15 healthy plants as control. Using the 305 base pair DNA as marker, they could easily distinguish between infected and non-infected seeds. Even with very small, femtograms of DNA, the scientists could detect *P. sorghi*.

The team then tested the method with another 12 well-known fungal phytopathogens. Since they observed no cross reaction, they report that the test is very specific and that the method

is more rapid, sensitive and less laborious than traditional methods.

The real-time polymerase chain reaction technique has increased sensitivity, specificity and reproducibility for detecting low concentrations of pathogen DNA. It might prove useful in detecting other fungal pathogens also. Now, it is up to scientifically-oriented entrepreneurs to market this idea as a diagnostic kit for farmers.

Eur. J. Plant Pathol., **150**(2): 521–526

Producing Monosex Tilapia Alternative to synthetic steroids

Tilapia is a widely cultured fish – second only to carp in global production. It is easy to spawn, grows rapidly and is less vulnerable to disease. It has high consumer acceptance and gives high returns to the fish farmers.

Tilapia females reproduce when still small and show stunted growth when the fish density is high. The males, on the other hand, grow faster and bigger. To get an all-male tilapia harvest, farmers use synthetic steroids. However, synthetic steroids pose many ecological and health hazards.

Recently, to culture monosex tilapia, researchers from the University of Calcutta and the Kaposvár University, Hungary used eco-friendly natural compounds: seeds of the Bengal velvet bean – *Mucuna pruriens* – and roots of shatavari – *Asparagus racemosus*.

They extracted plant metabolites with water, ethanol and methanol. And they administered these extracts to mixed-sex tilapia juveniles, as dietary treatment. The team found that extracts, with different solvents of both plants, had steroids/terpenoids, saponins and flavonoids. They observed that the extracts of Bengal velvet bean seeds produce a higher percentage of males than treatments with shatavari root extracts.

The scientists found that, in a dietary administration of methanol extract of Bengal velvet bean seeds, a concentration of 0.2 g/kg in the feed was best for producing all-male tilapia. However, further studies are required to estab-

lish an ideal treatment regime using plant materials.

The report might prove useful to develop an eco-friendly aquaculture technique, replacing synthetic hormones and chemotherapeutics with biodegradable natural compounds.

Turk. J. Fish. Aquat. Sci., **18**: 267–275

Cross-country Virus Transmission Threat to Tilapia



Image: Wikimedia Commons

Tilapia, the second largest group of farmed fish worldwide, is a commercially important protein source. However, this species, relatively resistant to infections, suffered an extensive viral epidemic in 2014. This first outbreak of the Tilapia lake virus resulted in high mortality and impacted the economics of aquaculture. Since then, there have been many outbreaks across the globe.

Last fortnight, a team from different ICAR organizations across the country reported incidences of tilapia virus in Indian aqua farms from West Bengal and Ernakulum. They analysed a total of 15 virus infected tilapia fishes from the West Bengal farm, using skin discoloration and detached scales as morphological features of the infection. They performed histopathological analyses and observed necrosis of liver hepatocytes as well as haemorrhages in brain cells – characteristic effects of the virus infection.

Next, they isolated viral genome from organ tissues and confirmed it to be closely related to a virus outbreak from Israel. They then infected a clinically healthy set of 25 tilapia with virus isolated from infected organs. The researchers found internal lesions in liver and brain cells of the test set after 10 days, showing that the virus can spread in a population.

Tilapia viral outbreaks could impact production worldwide and pose a threat to food security. The FAO has even issued a biosecurity alert against the virus. There is an urgent need for an effective method to contain the spread of the virus and to overcome infections in aqua farms.

Aquaculture, **484**: 168–174

Preventing Heart Failure Is oolong tea the answer?

The WHO estimates that 31% human deaths are caused by cardiovascular disorders. More than three-quarters of heart disease-related deaths take place in low and middle income families who cannot afford expensive treatments. The expenses associated with treatment continue to soar. Under such conditions, prevention is indeed better than cure.

Last fortnight, researchers from the Bharathiar University, Coimbatore, in collaboration with medical universities in Taiwan, identified cardioprotective properties in semi-fermented oolong tea. They extracted the oolong tea by partial oxidation and fermentation of freshly harvested young tea plant shoots. This extract contained higher levels of polyphenols, caffeine, and total catechins than green and black tea. Moreover, the extract also contained a powerful antioxidant, epigallocatechin-3-gallate, that effectively neutralized the reactive oxygen species present in female embryonic rat heart fibroblast cells.

The researchers found that oolong tea extracted at low temperature steaming offers better and longer protection against cardiovascular disorders. They claim that the cardioprotective effect is due to the suppressing of a signalling pathway that induces hypoxia and causes cellular damage under oxidative stress conditions. Oolong tea enhances cell survival by suppressing apoptosis – a cell self-destruction programme which generally occurs to prevent the spread of disease to healthier cells.

Cardiovascular disorders, according to the American Heart Association, pose a 20% risk at 24. The risk is more than double at 45. And, at 80, the risk is 90%! Surely, it is easier to lower the

risk by simply drinking oolong tea – affordable protection against cardiac diseases.

Environ. Toxicol., **33**(2): 220–233

Nano-bioglass Ceramic For bone tissue engineering

Ceramic materials have been extensively used in bone grafts, as their composition is similar to that of the mineral part of bone. Also, they are bioresorbable. However, ceramic materials have poor mechanical strength and a faster dissolution rate.

Bone tissue engineering is a better alternative to the conventional use of bone grafts, due to the unlimited supply of materials: the repair process uses the patient's own tissue. One of the challenges in bone tissue engineering is fabricating scaffolds with mechanical, structural, surface-chemical, topographical and biological properties suitable to regenerate critical size cortical bone. In recent times, bioactive glass ceramic has attracted attention in this regard. It is widely applied as a material for bone tissue regeneration.

Last fortnight, scientists from the Chettinad Academy of Research and Education, Kelambakkam, the Madras Institute of Technology, Chennai and the SRM University, Kattankulathur, reported developing a bio-active glass ceramic with better bone forming abilities. They focused on treating bone defects, with biomaterials in combination with a homeopathic remedy.

They synthesized nano-bioactive glass using a sol-gel method and doped it with *Calcareo phosphorica*, a homeopathic prescription for bone related diseases.

The scientists analysed the surface topography, morphology and particle size of the nano-bioactive glass and the *Calcareo phosphorica* doped nano-bioactive glass ceramic using Scanning Electron Microscopy. They found calcium ions deposited over the crystalline structure, indicating the aggregation of *Calcareo phosphorica* on the surface of the nano-bioactive glass ceramic. Instead of the rod-shaped crystals of bioactive glass ceramic, the doped material showed more spherical shapes.

The researchers tested the toxicity of the particles by colorimetric quantification and found that a concentration of up to 0.1 mg/ml had no toxic effects. They found that the material leads to an 18% increase in proliferation of osteoblasts *in vitro*.

They claim that their findings may pave the way for new insights into developing the biomaterials with potential bone formation capability. The material needs further testing *in vivo*, for bone tissue engineering.

Mater. Sci. Eng. C., **83**: 202–209

Self-Cleaning Cotton Fabric Superhydrophobic, superoleophobic

Apart from looking good, clean clothes help keep away unpleasant body odours. They also protect us from harmful microorganisms, which, otherwise, make dirty clothes their home and cause skin infections.



Image: Wikimedia Commons

Every day, people working in industries, hospitals, warehouses, shops, and garages struggle to keep their clothes clean. In a climate like ours, cotton clothes are preferable. But they are difficult to maintain.

To overcome the issue, a team from the NIT, Rourkela and the IIT-ISM, Dhanbad, recently reported developing a liquid repellent coating on cotton fabric, with excellent self-cleaning and oil-water separation properties, like that of the lotus leaf. Silicon tetrahydride, and its derivatives, where hydrogen is replaced by other atoms or groups of atoms, commonly known as silanes, are used for corrosion protection, adhesion promotion and other surface modification applications. The researchers fabricated superhydrophobic and superoleophobic coating on cotton fabric using two fluoroalkyl silanes – trichloro

(octadecyl) silane and (pentafluorophenyl) triethoxysilane.

The researchers used commercial white cotton fabric as substrate in tests for different capabilities. They placed droplets of different solutions, with different surface tensions, on the coated fabric surface to test wettability. The coated cotton fabric showed superhydrophobicity with hot water and repelled liquids like ethylene glycol and glycerol.

The scientists observed optical images of water, glycerol and ethylene glycol droplets on the coated fabric after immersion with different solvents for four days and confirmed chemical stability. They also annealed coated fabric in an oven for one hour at an elevated temperature of 50°C to 160°C. The fabric showed no change in colour or damage, proving its thermal stability.

The team also conducted a water jet impact test on the superhydrophobic and superoleophobic coated fabric. The water jet bounced off in opposite directions, showing the mechanical stability of the coating. The researchers observed negligible stains on the silane-coated fabric after annealing at 40°C for 15 minutes with coloured droplets. This confirmed stain resistance. The coated fabrics also showed excellent stability after exposure to UV irradiation for 35 hours.

When the scientists poured water on the silane-coated fabric, it rolled off, carrying away dust particles and leaving a cleaned surface, evidencing excellent self-cleaning behaviour. Then, they prepared a mixture of oil (kerosene/benzene/petroleum ether) and water, and poured it on the coated fabric. The team also found that they could efficiently collect oil and water separately from the fabric.

They conclude that the superhydrophobic and superoleophobic silane coatings are suitable for many industrial and engineering applications. The textiles are also useful for making fire retardant, waterproof clothing, stain resistant surgical and other household products, they claim. The solution immersion technique they used is simple, single-step and cost-effective.

Carbohydr. Polym., **181**: 1052–1060

Anti-bacterial Filter Paper *Water purification made easy*

Water-borne diseases spread like wildfire, and possess the strength to wipe out an entire population. In India, access to hygienic drinking water is limited to locations in and around water treatment plants. With the advances in technology, today we have microfiltration, ultrafiltration and even nanofiltration. But these are either time consuming or cost intensive. We need a mobile and economical solution.

Last fortnight, researchers from the Guru Jambheshwar University of Science and Technology in collaboration with scientists from Canada and the Republic of Korea reported developing an anti-bacterial filter paper, for water purification. Neeraj Dilbaghi and team focused on two aspects of the cellulose foam filter paper – wet strength and antimicrobial activity.

First, they prepared a cellulose foam paper by diluting, disintegrating and refining a softwood pulp suspension. They used surfactants to stabilize the structure of the cellulose paper. Next, they converted the cellulose foam paper into antibacterial water filter paper by immersing the foam paper into a glutaraldehyde solution and heating it. Glutaraldehyde is a potent disinfectant, regularly used for sterilization. To enhance linkages between the fibres, the scientists used a butanetetracarboxylic acid solution, a cross linking polymer. Thus, they increased the wet strength of the paper.

The team found that the fibres rapidly absorbed water and were, thus, not strong enough. Hence, they added polyacrylamide, along with glutaraldehyde, during the manufacturing process. Polyacrylamide introduced hydrophobic groups and increased the strength of the paper further. Thus, they have developed a new porous cellulose filter paper, which can, potentially, be used for water filtration.

The scientists tested wet strength performance using a vertical tensile tester. They found that adding glutaraldehyde along with polyacrylamide enhanced the filter paper's wet strength and that rinsing time did not

affect the strength of the filter paper significantly.

The team then tested the antimicrobial activity of the filter paper using a turbidimeter against five test cultures, including both Gram-negative and Gram-positive bacteria. They found that the filter paper was an effective microbial growth inhibitor.

The photographs of the filter paper, taken using a scanning electron microscope, showed that its structure is non-uniform. This increases the probability of particles, including bacteria, getting stuck to the paper.

The research community can explore and study the effects of the antimicrobial filter paper and collaborate with industry to scale-up this invention to provide potable water in remote villages.

Carbohydr. Polym., **181**: 1086–1092

Transparent Conducting Oxides *For solar cell applications*

Solar cell applications call for materials with lower band gap energy, high transmittance and greater carrier concentration. Attempts to increase conductivity usually end up reducing transparency. So, scientists have been doping transparent conducting oxides with suitable materials, hoping that a combination of metal and metal oxide will produce materials with high transmittance and low resistivity.

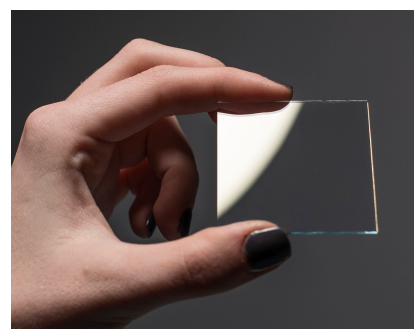


Image: Adafruit Industries/Flickr, CC

Last fortnight, scientists from the Alagappa University, Tamil Nadu in collaboration with a scientist from the Shizuoka University, Japan made a detailed analysis of transparent conducting oxide materials and came up with a new class of material, cadmium stannate, for this purpose.

They prepared cadmium stannate thin films using magnetron sputtering – a plasma vapour deposition technique. And reported that the surface of the deposited thin films show smooth surfaces with nano grains.

The recorded optical transmittance and absorbance spectra of cadmium stannate films show high transmittance of the order of 80% in the visible region, they report. But more importantly, the optical band gap decreased to around 2.5 eV from 3.0 eV. The electrical analysis revealed that the film has low resistivity and higher carrier concentration.

Thus, the scientists claim that the thin film prepared using cadmium stannate – a ternary combination of a transparent conducting oxide material – has good electrical conductivity, wide band gap, and is highly transparent to visible light. Therefore, it is a reliable candidate for solar cell devices. However, the efficiency of these materials for solar cells in field applications has yet to be tested.

The researchers also claim that the application of this material is not limited to solar cells. It is suitable for optical-to-electrical transducers in optoelectronic devices and so they hope that this material has scope for future developments.

Ceram. Int., **44**(2): 2529–2538

Arresting Hydrazine An environmental pollutant

Hydrazine, a compound with two nitrogen and four hydrogen atoms, is a seemingly harmless, colourless liquid. It is used extensively in pharmaceutical, chemical and agricultural industries. But it poses an environmental threat. It damages the nervous system, liver and brain upon exposure. Hence, we must detect and capture the carcinogenic compound.

Last fortnight, researchers from the Madurai Kamaraj University in collaboration with the Utah State University reported identifying aluminium-doped boron nitride nanotubes as a material to arrest hydrazine.

Several studies on the decomposition of hydrazine into hydrogen and

ammonia reveal that hydrazine adsorption depends on hosts and active sites on the surface of the compounds. The scientists used the density functional theory to describe the adsorption of hydrazine in interactions between hosts and guests in the compounds.

Boron nitride is one of the best adsorbents. It contains both Lewis acid and base centres, alternate to each other at the surface, giving more scope to interact with hydrazine derivatives. However, smaller diameter tubes form weaker interactions due to their high structural strain. This limits the use of boron nitride nanotubes as hydrazine adsorbents.

Previous studies show that aluminium-doping enhances the adsorption energy of boron nitride nanotubes. The aluminium atom, being larger than boron, is well above the surface of the tube and makes the tube more absorbent: adsorption energy increases from 10–70 kcal/mol to 32–35 kcal/mol.

The scientists say that the aluminium doped boron nanotubes could be an alternative to metal-based materials for hydrazine adsorption.

Struct. Chem., **29**: 375

Recommending Books Challenge for universities

The Indian tertiary education sector has seen a quantum leap in this decade. The number of universities has doubled. So has the number of new books published. Which books should be recommended to the students?



Image: S. Suresh Ramanan

Universities recommend books based on experts' personalized rec-

ommendations while framing syllabus. However, this leads to large variations in the list of books recommended by different universities, raising the question: which list is better? How do we reduce the personal and subjective biases of the experts that recommend books for university curriculum?

Last fortnight, a team of researchers from the Aligarh Muslim University reported a solution: Ordered Weighted Aggregation of a ranked recommendation. First, the team selected the leading Indian universities in the field of computer science and information systems, based on the QS World University ranking. These top universities had recommended a total of 158 books for ten courses.

The team allotted ranking to the books based on the syllabus of the leading university in the list. They gave weightage to the university rank, as well as to the book ranking. Thus they came up with a final list of books that can be recommended for each course separately.

The team then compared the results of the study with un-weighted aggregation based scoring where university ranking is not taken into account. Experts from different parts of the world compared the two lists and agreed that the list created using ordered weighted aggregation is better.

Ordered Weighted Aggregation does better because it normalises the differences in the personal knowledge and preferences of the experts as well as the differences between universities. Now it is up to academicians, students and librarians to use this tool effectively.

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