

Current Science Reports

Assessing Liquefaction Hazard

A case study of Jammu

Jammu, a high seismic activity zone, is prone to disastrous earthquakes. During earthquakes, soil behaves like a liquid. The ground moves in waves, cracking surface structures and underground utilities. How do we assess the hazard posed by such liquefaction in Jammu?

A team from IIT Delhi and NIT Srinagar collected standard penetration test and bore hole data about the area from geotechnical consultancies. This provided information on the geotechnical properties of the soil there.

From shear wave velocity in the specific types of soils, they could predict soil behaviour dynamics in the region. The central part of Jammu had low to high susceptibility to liquefaction. In the southern part, it was very high.

An examination of the area revealed a 20-metre long ground rupture near the Jammu airport and sand blows near Dugh Nala. A sand blow is a mixture of sand and water that rises to the surface during an earthquake.

The team generated an index to characterise the liquefiable zones. The index showed that several localities near the banks of the Tawi river, including Jammu University, are prone to severe liquefaction. The area around the banks of the Ravi in Jammu had young alluvium, with high probability of liquefaction. So structures in Kathua may be at risk.

Regions such as Chak Lalushah and Babliana in Jammu also had high probability of liquefaction due to uniformly graded soil at shallow depths. Such soil reduces the change in the volume due to the strains induced by earthquakes, unlike well-graded soil.

'Our integrated hazard maps show that the banks of the Tawi and the Ravi have high potential of liquefaction,' says Falak Zahoor, NIT Srinagar.

'Engineers can use this data to design structures. And town planners can make decisions for liquefaction mitigation in the Jammu region,' adds Abdullah Ansari, IIT Delhi.

DOI: 10.1007/s10064-022-02852-3

Drought Stress in Watermelon

Regulated by aquaporins?

Drought and salinity stress affect the movement of water across cell membranes in plants. Aquaporins, cellular plumbing systems, help maintain water homeostasis under environmental stresses.

How does the genetic expression of aquaporins regulate water transport under drought?

Researchers at the National Agri-Food Biotechnology Institute, Mohali, the Panjab University, and the Central Institute for Arid Horticulture, Bikaner, collaborated to investigate drought-induced aquaporins in watermelons.

From a watermelon genome database, they identified 35 major aquaporins. Aquaporins are present in watermelon roots, leaves, stems and fruits.

The team found that, under drought stress, 25 of the 35 watermelon aquaporins were expressed in the fruit, and 30 in the leaves. Coexpression networks of aquaporins showed that, under drought stress, there was simultaneous increase in the expression of aquaporins in leaf vacuoles and flowers.

The researchers then grew watermelons up to the mature fruiting stage and subjected them to salinity and cold stress. During cold stress, aquaporins in leaves were significantly up-regulated. And under salinity stress, aquaporins were up-regulated in roots. This suggested that watermelon has flexible mechanisms to adapt to stress.

Methyl jasmonate, a plant hormone, plays an important role in adaptation to stress. The researchers treated watermelon with the hormone and found increased activation of aquaporins in vacuoles, accelerating fruit growth.

Regulating aquaporin activity and gene expression is a vital part of the adaptation mechanisms. So identifying key aquaporins and growth hormones that regulate their expression can help farmers take appropriate steps to counter unexpected droughts.

DOI: 10.1007/s00344-022-10776-1

Water-absorbing Polymer

Managing water stress

Water-absorbing polymers or superabsorbent gels help improve the soil's water retention capacity. They can store up to five hundred times their weight in water. Can applying fertilisers affect the capacity of their water retention properties?

Recently, researchers from IIT Guwahati investigated the effects of organic and inorganic fertilisers on the water retention capacity of these gels. First, they determined the water absorbing capacities of both polymers in distilled water and tap water.

To assess the performance of two water-absorbing polymers along with fertilisers, they chose commonly used fertilisers – urea, diammonium phosphate and cow manure.

The researchers collected several agricultural soil samples and estimated their properties. They then added different concentrations of the polymers to the soil using tea-bag like pouches and observed water absorption in all set-ups. They added 4 per cent of inorganic fertilisers and 10 per cent of organic fertilisers to dried soil samples, in various combinations.

Each of the soil samples was uniformly irrigated. Water absorbing polymers were added and the researchers noted changes in water volume in the soil using sensors. With increasing concentrations of fertilisers, the soil's capacity to retain water was reduced. The effect was similar with both polymers.

The soil's water holding capacity was maximum when the soil was amended with a water-absorbing polymer, and a combination of organic and inorganic fertilisers.

The researchers suggest combining fertilisers with superabsorbent gels to address crop failures due to drought.

DOI: 10.1016/j.still.2022.105449

Fermented Soybean Foods

Managing diabetes

The low prevalence of diabetes in east and southeast Asia has been attributed

to the consumption of fermented soybean foods. The fermented foods of these regions have been extensively investigated for their nutritional qualities.

In the northeast of India too, a variety of fermented soybean preparations are routinely consumed. Yet we lack research on their nutraceutical properties.

This lacuna has now been rectified by Indian researchers who investigated the antidiabetic properties of such foods.

They made aqueous extracts from six preparations of fermented soybean: akhuni, bekang, hawaijar, kinema, peruyaana, and tungrymbai.

They treated cultured rat muscle cells with the extracts along with normal and high glucose concentrations, and used extracts of non-fermented soybean as control. The uptake of glucose and glucose-6-phosphate was reduced in rat muscle cells exposed to high glucose.

Among the extracts of the six fermented soybean preparations, the aqueous extract of hawaijar showed the best results in increasing the uptake of glucose and glucose-6-phosphate. The expression of signalling proteins involved in glucose metabolism was also increased.

Encouraged by the *in-vitro* experiments, the researchers tried hawaijar extracts on rats. In rats fed on a high-fat diet alone, within four months, there was an increase in body weight, elevated insulin resistance and impaired glucose tolerance in skeletal muscles. However, when rats on the high fat diet were also given aqueous extracts of hawaijar at various concentrations, these effects were significantly reduced in a dose dependent manner.

Since some antidiabetic medications impact liver and kidney functions, the researchers checked and found that the extract induced no significant changes in the biochemical and molecular markers of kidney and liver functions.

A profiling of proteins in fermented and non-fermented soybean showed that the dietary soy proteins, conglycinin and glycinin, common allergens in soybean, are absent in the aqueous extract of hawaijar. Fermented soybean

has low molecular weight and bioactive proteins that are potential antioxidants.

A chemical profiling of the aqueous extract of hawaijar identified isoflavones, a group of flavonoids, in their bioactive aglycone form. Aglycones are reported to be absorbed faster and have nutraceutical effects.

Diabetic patients may consider borrowing the recipe for preparing hawaijar, an indigenous fermented soybean food of Manipur.

DOI: 10.1111/jfbc.14385

Oral Cancer *Procaine as drug*

Oral cancer is associated with DNA hypermethylation. DNA methylation can be inhibited by procaine, a local anaesthetic.

Can procaine be used against oral cancer?

To investigate, a team from NIT Rourkela collaborated with Indian researchers in Saudi Arabia and Singapore.

They cultured human oral cancer cell lines with different concentrations of procaine. Using a fluorescent microscope, the researchers studied the cells after staining them with acridine orange, an easy way to identify autophagy, the body's way of clearing damaged cells. Procaine increased autophagy.

To count the dead cancer cells, the researchers used trypan blue, which stains dead tissue. Increasing the procaine dose increased cancer cell death.

They investigated whether there was any synergy between procaine and anti-cancer drugs. There were higher levels of cell death with procaine and cisplatin than with procaine or cisplatin treatment alone.

How does procaine work? Paired box 9, a transcription factor coded by the *pax9* gene, regulates tumour formation. Deactivating the gene causes tumour progression. Could this be how procaine acts?

To check, plasmids, small pieces of DNA, with the *pax9* gene and siRNA which silences the gene's expression were introduced into the cell culture. Western blot showed an increase in

pax9 gene activity with procaine despite the silencing RNA.

Procaine is approved for dental surgery. To use it for oral cancer, more studies are needed.

DOI: 10.1016/j.bbadis.2022.166428

Use of Maternal Health Services *Trends and determinants*

The Government of India has launched several programmes to reduce maternal and child mortality and morbidity. But do mothers effectively use the services? What difference have these programmes made?

National health surveys by the Indian Ministry of Health and Family Welfare can be used to assess the programmes. Dhiman Debsarma and team from JNU, New Delhi, compared data from the third survey in 2005–06 and the fourth in 2015–16.

They found that urban women made more prenatal visits during both survey periods. There were more institutional deliveries in urban locations. Institutional deliveries and the use of maternal services were higher during 2015–16. But rural and urban poor lagged.

The number of antenatal visits was highly correlated with the wealth index, mothers' level of education and birth order of children. Watching television and being older were both correlated with institutional delivery. Higher maternal age and wealth index were related to complete prenatal care.

Though there has been an improvement in pregnant women using the services from the third to the fourth National Family Health Survey, rural and urban poor are not using the services. There is a need for awareness campaigns to encourage greater use of public health facilities.

DOI: 10.1016/j.midw.2022.10338

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ACKNOWLEDGEMENT: NCPOR, Goa for access to scientific databases.

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