Science Last Fortnight

Crops of the Future

Sea rise, one of the consequences of climate change, threatens farmers across the coastal lines. There is an agricultural crisis due to frequent flooding, drought, soils degraded by agrochemical overuse aggravated by the rising sea engulfing coastal farmlands. But there are some plants that can tolerate higher salt concentrations: halophytes.

Aditya Rathore and team from the Central Salt and Marine Chemicals Research Institute, Bhavnagar, Gujarat, have also proposed that halophytes act as an excellent sink of atmospheric carbon dioxide. According to them, abiotic and biotic variables work in combination, interacting in complex ways to modulate this effect. The understanding of the soil nutrient–halophyte relationship and biotic and abiotic stresses can open new avenues in exploiting the carbon fixation potential of halophytes.

Intertidal sea shores have plenty of mud-flats and salt marshes due to tidal oscillations. This supports the growth of *Salicornia brachiata*, a halophyte. Their ion physiological features allow them to cope with the saline substrates. They adapt to different physicochemical environments and show high productivity in the salty ecosystem. They accumulate salt in their succulent structure to adjust the low osmotic water potential of the soil. Thus, it becomes a source of high value vegetable salt.

Salicornia brachiata is considered a potential alternative crop of seawater agriculture, due to its economic potential: its seeds yield special quality oil, a highly polyunsaturated compound rich in linoleic acid, similar to safflower oil. It is also a source of high value vegetable salt. Moreover, the *Salicornia* species, which can tolerate nearly twice the salinity of seawater, is seen to have enormous potential as a biofuel crop.

Despite these potential benefits, saltwater agriculture is still not exploited. For farmers, saltwater still spells crop failure. Sea level rise due to climate warming and increased soil salinity due to irrigation, will require new crops to be introduced to farming communities.

International Journal of Phytoremediation, 2016, **18**(8), 801–811

Manish Kumar Tekam

Traffic Accidents!

Pedestrian risk perception

Pedestrian–vehicle crash is on the rise across the world. National Crime Records Bureau statistics state that India witnessed a death toll of around 1.41 lakhs persons whereas persons who suffered injury in traffic crashes were around 4.77 lakhs in 2014. Pedestrians have a sizable share of 51% among the 58% fatal accident under the non-motorized category. Experts point out that actual figures would be higher, as most cases are not reported.

Shalini Rankavat and Geetam Tiwari, from IIT Delhi, examined the pedestrian perception of risk. Based on data from 2006 to 2009, Delhi, they analysed the degree of fatal crashes, locations and built environment. And they administered a questionnaire to understand the relationship between these factors and the perception of risk.

When they analysed the data on risk perceptions based on age, gender and demographic characteristics, they found higher risk perception in males than in females, indicating that males are more cautious in high risk areas than their counterparts.

The researchers used the logit model of risk perception to highlight road features, traffic characteristics and overall built environment as major factors in pedestrian–vehicle crash. Built environment also modifies pedestrian risk perception. Detailed approaches of this kind would help prioritize pedestrian safety and provide clues for the modification of cities to reduce traffic problems.

Safety Science, 2016, **87**, 1–7

Bobby P. Mathew

Salt-Tolerant Peanuts

Peanut is a marginal and low-resource demanding crop. This leguminous species is found to be moderately salt sensitive. Developing salinity tolerant genotypes would help expand the area of cultivation in non-traditional, saline soils also.

Plants are sensitive to salinity. It limits growth and crop productivity. Since plants cannot move to escape stresses, they have evolved strategies to cope. They have acquired several mechanisms to acclimatize to salinity, the most common abiotic stress. Plants first 'sense' environmental cues, before responding. It is now established that different plant species respond differentially by modulating their antioxidative machinery.

Salinity stress generates Reactive Oxygen Species, otherwise called free radicals. These are harmful by-products of cellular metabolism. They are also considered to be signalling molecules regulating stress tolerance.

A team from the Directorate of Groundnut Research, Junagadh, investigated the responses of different genotypes of peanuts to varying salt stresses. There were changes in enzyme activity detected at both the RNA and protein levels, and non-enzymatic antioxidant activity at the protein levels. They confirmed the presence of free radicals using spectrometry and *in situ* histochemical staining methods. Sensitive genotypes of peanut succumbed to salt stress due to a reduction in membrane stability.

Results revealed that the induction of all the antioxidant enzymes does not occur simultaneously. Instead, salt stress induces one or other components selectively. The process of detoxification occurs in phases, with specific enzymes acting in each phase.

The co-ordinated mechanism of detoxification of free radicals in peanuts has been unraveled in this study. The first line of action is superoxide dismutase. The free radicals generated by its activity are broken down by peroxidase, ascorbate peroxidase and catalase. Peroxidase and ascorbate peroxidase are active at low concentrations of free radicals while catalase is more constitutive in nature.

Specific components of the plant defence system thus play crucial roles. This varies from crop to crop. So, it is important to identify crop-specific components underlying salt tolerance. The study of salt tolerance in peanuts may, however, help in creating a general theory of salt tolerance in other crops.

Environmental and Experimental Botany, 2016, **128**, 79–90

Rekha Warrier

Transcription Factors in Diseases

More than DNA binding

Transcription factors are proteins that regulate gene expression in living cells. By binding to DNA, they initiate the decoding of genes into proteins. Angshuman Bagchi, from the University of Kalyani, looked for the roles of transcription factors from pathogenic organisms in virulence and disease.

Transcription factors are classified into families based on their DNA binding region or domain. Anshuman analysed the variations in the amino acid sequences of domains within each family of transcription factors. He predicted new domains based on the structural differences in transcription factors.

As expected, new domains were found in transcription factors from 13 pathogens. These domains may be involved in several processes ranging from platelet aggregation, assembly of tails and replication of viruses, and prevention of the growth of beneficial bacteria in humans. These domains may also be involved in hampering the immune system and DNA replication in humans.

Finally, Angshuman Bagchi assigned new functions to the transcription factors. Notably, transcription factors from *Mycobacterium leprae* and *M. tuberculosis* have a pollen allergen domain. This domain might help increase the virulence of the pathogen through carbohydrate binding. Similarly, a transcription factor from *Pseudomonas aeruginosa* might play a role in infecting individuals with Werner syndrome.

These findings may help identifying new therapeutic strategies.

Gene, **586**(2), 274–280

Saravanan Parameswaran

Black Panacea for Jaundice!

Black seed oil was first found in Tutankhamun's tomb, in an Egyptian pyramid. Prophet Mohammed is reported to have said: 'Black cumin cures every disease but death itself'. *Nigella sativa*, known as 'Kala jeera', is a significant constituent in Ayurveda and Siddha. These seeds contain more than one hundred chemical constituents and vitamins. Now, a study conducted by Younis and her associates from the Aligarh Muslim University and the Qassim University, indicates that the thymoquinone present in the seed may aid in treating jaundice.

Jaundice is manifested by the characteristic buildup of bilirubin, a toxic digested product of hemoglobin. Spectroscopic measurements in the range of 350–550 nm indicate that thymoquinone binds to bilirubin. Bilirubin is optically inactive. However, when bound to thymoquinone it becomes optically active. Fluorescent studies confirm the interaction between these molecules.

Free bilirubin has a tendency to bind red blood cells and thus becomes toxic. Comparative binding studies show that thymoquinone inhibits the binding of bilirubin with RBCs. Thymoquinone stops cell lysis even when the bilirubin concentration is as high as 100 mM.

Scientists also experimented with CYP, a chemical that induces cell lysis. As all other drugs, CYP is also cleared through the liver. It can lead to severe inflammation and hemorrhage. The study indicated thymoquinone treatment reduced the symptoms. A dosage of 10 mg/kg prevented the formation of free radicals in the liver, thus reducing toxicity. A fat based formulation of thymoquinone was more effective because it is fat soluble and this aids absorption.

Thus, the panacea from ancient Egypt was shown to be therapeutic against a dreaded ailment.

Biochimie, 2016, **127**, 205–213

Manali Datta

Camphor in Cinnamon Leaves

Native varieties show promise

Cinnamon is popular in India – as a condiment and flavouring material. The genus, *Cinnamomum*, has many evergreen aromatic trees and shrubs. The aromatic oils are present in leaves and bark. Some species produce camphor also.

An endemic species, *Cinnamomum agasthyamalayanum*, was recently described from the southern Western Ghats in Kerala. The species has a strong camphor smell in its inner bark and leaves. A team from the SASTRA University, Thanjavur, studied camphor levels in two distinct populations of the species found in the Western Ghats. The essential oils were profiled using chromatography. And they compared camphor levels in the leaves of both populations with camphor levels in cultivated species. Camphor comprised more than 50% of the essential oil composition in the new species. So, the species has potential as a natural source of camphor!

Commercial natural camphor is usually found in the wood and roots. But in this species, the leaves have high camphor levels. This unique trait of the species will help avert the need for destructive harvest for the extraction of camphor and yet provide large enough quantities for market demand. The content can perhaps be improved further through breeding for commercial utilization.

Industrial Crops and Products, 2016, **86**, 259–261

Rekha