Designed to cope with drought

So far breakthroughs in the field of agricultural sciences have focused on crop varieties that produce greater yields within shorter time periods. However, the challenge today is climate change, which has resulted in increasing frequencies of prolonged drought periods. The 2012–2014 drought in California, USA, saw huge crop losses, compelling the farmers to abandon their fields and orchards. At home, the arid regions in western and central India and the Deccan plateau have witnessed severe water scarcity year after year, threatening the food security in the region. At such a time, cultivating crop varieties that can cope well in scarce water conditions is the need of the hour. Scientists from the University of California, USA, have designed a novel technique to acquire plant varieties that are tolerant to drought conditions.

The surfaces of leaves in plants are covered by small pores called stomata. Each stoma is bordered by two special functioning cells called the guard cells. These guard cells are responsible for regulating the size of the stomatal pore. During the process of photosynthesis, plants take in carbon dioxide from the atmosphere and release back oxygen as a by-product through these openings. During the night, water vapour is released through the same pores by a process called transpiration. The rate of transpiration depends on many factors such as the amount of water absorbed by the roots and the increase in temperature and humidity. When water is scarce, plants naturally produce elevated levels of the hormone absinic acid (ABA). ABA triggers specific protein receptors that induce the closing of stomatal openings, thereby reducing the amount of water lost through the process of transpiration.

In a recent study, Sang-Youl Park *et al.*[1] have successfully identified the protein receptors that when activated by the ABA hormone, control the mechanism of closing of the stomata aperture. Once the receptor protein for ABA was identified, the scientists marked the site at which ABA binds to it. Using protein engineering, a method by which variants of a protein can be constructed and tested for new properties, they created many genetic mutations. Each mutation was then tested with a host of chemicals that are commonly used in agriculture. After several trials using tomato plants with modified receptors, scientists found mandipropamid, a fungicide, was able successfully bind to the modified receptor and activate it, functioning in a manner similar to the ABA hormone, thereby making the plant more drought-tolerant. This was further confirmed during field trials where modified tomato plants sprayed with mandipropamid were found to survive water-scarce conditions better than the plants without modification.

Figure 1. Large areas in India have been experiencing drought due to monsoon failure (photo credit: K. Ramnath Chandrasekhar).

1. Park, S. Y., Peterson, F. C., Mosquna, A., Yao, J., Volkman, B. F. and Cutler, S. R., *Nature*, 2015; doi:10.1038/nature14123.

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MEETING REPORT

Unlocking the past*

Knowledge of what has happened to human life-support systems in the past should clearly be an important component of planning sustainable development in the future. In this context, reconstructing palaeoenvironment is an inevitable process in the narration of history. But, the written records of the past are limited to the last few thousand years. So, retrospection of environment through long-term archival records is becoming increasingly important in recent years. Geoarchaeological studies have made it possible to draw general conclusions about the broader picture of the past. They employ geomorphological and other natural science approaches along with archaeology to study human–environment interactions in the past. In our ever-changing world, with impact of climate and sea-level change on human

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habitats, geoarchaeological research is highly relevant. The way past cultures coped with environmental change and natural hazards provides important lessons for human responses to future environmental changes. Moreover, human activities have left several fingerprints on our natural environment during the past millennia, especially during the Anthropocene, the geological epoch debated by earth scientists as characterized by extensive anthropogenic influence[1]. Assessment of resilience of landscapes to human impact and environmental change can assist in solving present and future environmental problems. This requires a deep understanding of physical processes, including natural as well as anthropogenic drivers of environmental change.

To develop a concrete knowledge of the natural as well as anthropogenic drivers of environmental change, a winter school was organized by the Department of Archaeology, Deccan College Post-graduate and Research Institute (DCPRI), Pune on the occasion of its Platinum Jubilee year 2014. The focus was on motivated research scholars and young faculty members, promising postgraduate students who are planning to pursue research in geoarchaeology. The main objective of the workshop was to strengthen the links between geomorphology, archaeology and geology as well as to provide a new impulse to work in the science of archaeology. An overwhelming response was received with a total of 20 research scholars and faculty members attending the workshop from different reputed universities, academic and research institutions and government organizations with archaeology, anthropology, geology, geophysics and geography background. The workshop was inaugurated by Vasant Shinde (DCPRI), N. N. Maldar (Solapur University), Jayashri Sathe (DCPRI), S. N. Rajaguru (DCPRI) and P. D. Sabale (DCPRI). In his presidential speech, Shinde welcomed the participants and mentioned that the winter school provides a platform for young researchers to discuss application of sciences to archaeology and evolve novel solutions for interpreting the past. He focused on the role of environment in the decline of a civilization. Sabale gave a brief account of the course and its importance. He mentioned the valuable repositories for detailed records which provided important evidences about a long history of landscape development and human–riverine interaction throughout the Quaternary period. In his keynote address, Rajaguru highlighted the basic concepts of Stone Age archaeology and geoarchaeological perspective of past landscape.

The six-days programme constituted 30 lectures and four practical sessions, including field demonstration and a one-day field excursion. The thrust of the lectures was mainly on specific scientific approaches in geoarchaeology. The forenoon sessions were devoted to lectures and afternoon session for practicals. Reputed faculty members from different institutions and universities discussed scientific approaches for understanding past climate, natural processes and cultural phases using paleoflood studies, stable isotope analysis, dendroclimatology, archaeozoology, archaeobotany and Acheulian artifacts. In the practical session, participants were exposed to sedimentological and petrographic analyses, fluorine dating and phosphate analysis. The shallow subsurface data collection through ground penetrating radar was demonstrated by Sabale at the DCPRI campus.

Informal discussions and good interactions with faculty members and participants was a motive to work in the interdisciplinary area to solve specific problems on Quaternary paleoenvironment. There was a field tour to two Quaternary geoarchaeological sites, viz. Chandoli on the Ghod River and Junnar on the Kukadi River under the supervision of Sabale, Rajaguru and M. D. Kajale (DCPRI), which included detailed description of the fluvial responses to climate change using geoarchaeological approach. During the school, in continuation with the lectures, the most interesting aspect was the visit to the archaeological museum and Sankalia's gallery. In the valedictory speech, the chief guest Rajiv Nigam (National Institute of Oceanography, Goa) emphasized the progress of marine archaeology in India and mentioned that over the years, NIO, in collaboration with other Government agencies has undertaken the exploration and excavation of submerged ports and shipwrecks at Dwarka, Bet Dwarka and Somnath on the west coast of India. The feedback from the participants clearly indicated that the school was highly beneficial to them. The following recommendations emerged from the school: (i) despite the good information available for many archaeological sites, it is important to look at the modern approaches to explore and unlock the past; (ii) create better geochronological and other state-of-the-art analytical facilities for palaeolithic studies supported by government financial aid; (iii) specialized short courses and workshops should be held on different topics of archaeological sciences each year to aid young scientists in India.

Finally, to unlock the Quaternary palaeoenvironment, geoarchaeological approach is a must. So, a workshop of this kind is useful to participants in getting exposed to different fields of archaeology and learn to solve the problems through a multidisciplinary approach. The participants were encouraged to learn the content and process of scientific inquiry by engaging in research and group discussions and communicate their findings to others. In addition, the school provided an opportunity to the beginners to interact with some of the eminent workers from the scientific community. The organizers have been successful in achieving their mission of spreading knowledge and bringing the young generation of researchers in the field of geoarcheology.

1. Syvitski, J. P. M. and Kettner, A., *Philos. Trans. R. Soc. London, Ser. A*, 2011, **369**, 957–975.

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