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TNAU, Japanese professors unravel key genetic features of barley

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Singapore: India's Tamil Nadu Agricultural University (TNAU) professor Natesan Senthil and a Japanese professor have together identified the genes responsible for barley's domestication that transformed this once-wild food grain into an item of mass consumption. Their research work was published in the journal Cell on July 30, 2015.

Barley was the earliest domesticated crop in the world and the history of barley cultivation is much older than wheat. However, two key, unanswered questions have been asked for a long time, namely - how did the grain dispersal mechanism of wild barley evolve and how often, and where was the dispersal mechanism lost during the process of domestication?

Takao Komatsuda of the National Institute of Agrobiological Sciences, Tsukuba, Japan and Kazuhiro Sato of Institute of Plant Science and Resources, Okayama University, Kurashiki, Japan led a group of international collaborators which include Natesan Senthil, Professor of Biotechnology, Tamil Nadu Agricultural University, in the discovery of two genes, Btr1 and Btr2 that are involved in grain dispersal in wild barley at maturity.

These genes facilitate seed dispersal, which is essential for the survival of the species, but at the same time it makes harvesting of large amounts of grain virtually impossible. Today, barley is the fourth most important crop in the world - both in the size of cultivation and grain production, and its high production is due to its domestication that happened 10,000 years ago.

Takao Komatsuda, senior researcher at the National Institute of Agro-biological Sciences (NIAS), Tsukuba, Japan, explained that there was a problem with the wild variety. The spikes that contain the grain were brittle in the wild variety. This brittle nature breaks the spike, and the grain falls on the ground. While this is essential for the proliferation of the crop, it made harvesting difficult.

The rachis lost its brittle characteristic through isolated natural mutation events. These mutations resulted in a stronger, non-brittle rachis through which the grain remained attached to the head after maturity. Ancient farmers recognized that they could now harvest all the grains at the same time and selected the individual, naturally mutated barley plants for cultivation. This was therefore a centrally important step in the domestication of this early cereal crop species.

Professors Komatsuda and Sato along with Indian Professor Senthil have elucidated, for the first time, the genetic basis that led to one of the earliest human cropping activities and eventually to modern agriculture. In their research, two great mysteries about the evolution of wild barley and its transition to modern cultivated barleys were unlocked.

A natural mutation in one gene (Btr1) resulted in the establishment of cultivated barley in modern Israel about 10 thousand years ago, while an independent mutation in the other gene (Btr2) occurred later in North west Syria and south east Turkey.

The descendants of the two mutant, cultivated barleys differ in their nature, and represent a major source of the extremely high genetic diversity that exists in barley today. Now, with this discovery the researchers believe that introducing unused wild barley traits with new properties into the current breeding programs would offer opportunities to accelerate and improve the efficiency of breeding of barley.

Commenting on the discovery Professor Senthil said, "Barley that we are using today has been derived from one of the descendants of the first cultivated barleys that originated through either of the two mutations in wild barleys.

The modern day descendants carry a large amount of genetic material and associated traits from their ancient ancestors in which the mutations first occurred. For example, traits such as disease resistance, quality in the production of beer, nutrient value of livestock feed will vary greatly depending on breeding lineages.

Therefore, it is likely that the efficiency of breeding programs can be accelerated by exploiting used genes and taking advantage of the latest genomic information."

The understanding of the genetic features discovered by the researchers will now throw light on increasing the grain production as barley has been extensively used as animal fodder, as a source of fermentable material for beer and certain distilled beverages, and as a component of various health foods.