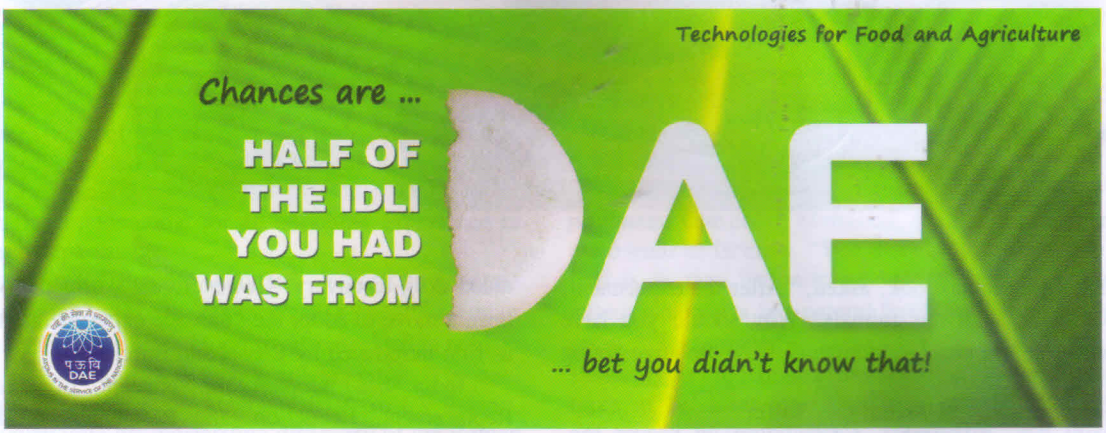
INDIAN S&T BREAKTHROUGHS

Using Radiation to Improve Crop Varieties



ATOMS and Agriculture

The biodiversity that we see around us is a result of spontaneous mutations that took place at the genetic level. A mutation is a genetic change that happens in living organisms, which is passed forward in the next generations. It is also a fact that mutations are the driving force of evolution. The frequency of such mutations can be increased through radiation. These radiations are used to bring genetic changes for obtaining desirable characteristics in crops. Mutation breeding, being one of the important breeding methods, has contributed significantly to crop improvement by bringing unique genetic variability, evolving superior varieties and rectifying popular varieties in various crops.

Thanks to government organisations like the Department of Atomic Energy (DAE) under the Government of India, which is engaged in ensuring the nation's food security. Scientists at Bhabha Atomic Research Centre (BARC), the premier multi-disciplinary R&D institution under DAE, have harnessed the wonders of mutation-breeding technologies for developing advanced crop varieties that have increased yield, disease-resistance, better adaptability, early maturity, etc.

Need for Mutations in Crop Plants

Scientists conducted extensive experiments to demonstrate that radiation-induced mutations can be harnessed to enhance crop plants. Although the mutation process was initially random, mutants exhibiting desired traits could be selectively bred, transferring those traits to cultivated crop varieties through traditional breeding methods. This pioneering work led to the emergence of Mutation Breeding as a distinct scientific field, resulting in the development of crop plants with a range of novel and beneficial characteristics. These advancements included increased yields through higher pod or seed counts per plant, enhanced disease and insect resistance, improved oil content and protein quality, adjusted maturity periods, and adaptability to various soil conditions. These mutant varieties also played a crucial role in meeting global food demands amidst growing populations and diminishing water resources.

According to the Food and Agriculture Organisation (FAO) statistics, between 2009 and 2050, it is anticipated that the global population will grow by more than a third, amounting to an increase of 2.3 billion individuals. The World Bank data indicator predicts a total global population rise, from 7.74 billion in 2019 to 7.95 billion in 2022. For India, the total population rise predicted is from 1.38 billion in 2019 to 1.42 billion in 2022. This clearly indicates that market demand for food will also continue to grow. In this case, different innovative methods will be required to enhance the crop production of desired quality so as to ensure safe and nutritious food for all.

Mutation Success Saga in a Different Plant Variety

While inducing mutations through radiation exposure is a straightforward task, the comprehensive process of developing a reliable cultivar with the desired mutation is notably time-consuming. Therefore, the challenge for a small team of fewer than a dozen scientists at Bhabha Atomic Research Centre (BARC), Trombay, Mumbai, working within limited experimental field areas, was to effect a lasting impact on the national agricultural sector and leverage the advantages of nuclear applications for farmers. This imperative led them to explore 25 different varieties of groundnut, pulses, oilseeds, rice, and jute.

Trombay Groundnut (TG)

Generally, groundnut exhibits limited genetic variability. However, among the induced mutants, two high-yielding Trombay groundnut varieties, TG-1 and TG-3, stand out.