Generation Challenge Programme

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World Café Session

Induced Crop Mutants: Vital genetic and genomics resources

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Preamble

I proposed this topic and was glad that it was accepted and more so to have been asked to host the session. For the purposes of full disclosure, my colleagues and I at the Joint FAO/IAEA are mandated with assisting "Member Countries of FAO and IAEA to use nuclear techniques and related biotechnologies for developing improved strategies for sustainable food security". Our crop improvement activities involve the induction of mutations in crops (both as breeding materials and genomics resources).

Introduction

Mutation, the naturally occurring heritable change to the genetic material, which plays a pivotal role in evolution and formed the bases for speciation and domestication of both crops and animals, can be artificially induced. Since the sublime discovery of X-rays and other forms of radiation in the early 20th century and the ensuing demonstration of the ability of these forms of nuclear energy to alter the genetic material, scientists have routinely used different types of ionizing radiation to create variants of crops. Over 3000 of the resultant novel crop varieties are now widely grown all over the world and on account of their superior traits such as hardiness, permitting cultivation under harsh environments, better nutritional qualities, and resistance to pests and diseases, contribute billions of dollars in additional income to farmers annually. These mutant crop varieties are replicating in various Member States the dramatically profound effects that spontaneous mutant dwarf and high yielding varieties of wheat and rice had on global food security in the 1960's and 1970's (the so-called Green Revolution).

The plant breeder's ability to improve a crop is as good as the available genetic variation that can be exploited in crosses and other forms of selection. Where the desired genetic variation is lacking, induced mutation offers the possibility to induce such variations. Significant efforts are currently being invested not only in the generation of genetic variations through induced mutations but also in the systematic characterization of the induced mutants for observed phenotypic and genomic changes and the cataloguing of the variations in searchable databases. The curators of these repositories invariably make these resources available to requestors (plant breeders and other scientists interested in gene discovery and elucidation of function) in the form of a service. I hoped to use the World Café session to sensitize the GCP community to the need for generating this resource being that with climate and variations and the uncertainties that they portend being the main drivers for crop improvement in the foreseeable future, strategies will have to be developed for the generation and characterization of the genetic variations that will be deployed in the mitigation of the envisioned extreme climatic conditions.

Synopsis of the session

- About 30 participants took part in discssuing this topic. These participants did not attend this session in discrete groups rather, the 'informal' nature was elasticized to mean, 'drop in at

will'. This however did not detract from the essence of the discussions as the discussants were mostly people with fairly well informed opinions on the subject.

- Terminology. From the outset, it became clear that the ARM discussants mirrored the wider scientific community's tendency to the lumping together of such strategies as insertional mutagenesis (using T-DNA, for instance), retrotransposons and classical radiation- and chemical-mediated induced mutagenesis together. For purposes of disambiguation, this session was intended for mutants induced through the classical methods, i.e. without any transgenic components.
- In general, discussants overwhelmingly favoured the establishment of characterised (phenotype and genotype) mutant stocks of the GCP crops. Concerns for the viability of these repositories included the articulation of mechanisms for:
    - Distribution of the accessions and issues relating to access;
    - Physical maintenance of the accessions including location;
    - Funding as this would entail additional substantial costs;
    - Allocation of responsibilities for the characterization; formation of networks, etc.
    - Logistics relating to IP issues
- Relating to above 'pro' stance was the suggestion for the establishment of a 'trust for genomics resources' for GCP crops. A comprehensively articulated workplan would address above concerns.
- The 'cons' opinions included:
    - There is no need to generate additional genetic variations; it could be more beneficial to identify the natural allelic variations – that have been found useful in crop breeding – and deploy those in crop improvement strategies. Ecotilling was identified as a mechanism for identifying the spontaneous mutation events.
    - Induced mutant stocks are expensive to maintain and could unnecessarily tie up the scarce resources available to GCP.
- The need for a research agenda on mutagenesis in GCP crops was emphasized severally. For induced mutants, this would involve methodologies for the generation of the mutants and the identification of the mutation events while for spontaneous mutants, only the latter would be applicable.