Protocols for Pre-Field Screening of Mutants for Salt Tolerance in Rice, Wheat and Barley

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Preface

The Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture has supported Member States in the use of nuclear techniques in plant breeding and genetics for over 50 years. This has been achieved through research and training especially in developing methods for mutation induction and mutation detection. Mutation induction in plants aims to generate novel genetic diversity for plant breeders targeting yield, quality, resistance to pests and diseases, and tolerance to abiotic stresses such as salinity. Induced mutation in plants began in the 1920s and the first mutant cultivar was "Vorstenland" tobacco released in Indonesia in 1934. Plant mutation breeding has been very successful, and today, there are over 3220 officially released mutant cultivars in over 210 crop species worldwide. World food security continues to be threatened notably by climate change, lack of agricultural land, and a growing human population. Thus, there is continual pressure on plant breeders to develop higher yielding crop cultivars. Plant mutation breeding can help meet these demands. One issue, however, is the ability to select mutants carrying desired traits as this requires the development of screening protocols. This booklet provides a simple protocol to screen for mutants in cereal crops tolerant to salinity.

The booklet has three main sections: (1) a brief introduction to the problem of soil salinity, (2) a protocol for measuring soil salinity, and (3) a protocol for screening for salt-tolerant cereal genotypes. The protocols are aimed to assist plant breeders and especially breeders who need to screen cereal populations, such as mutant populations, for salt tolerance. The protocols are designed to be effective, low cost, and user friendly.

The booklet provides simple and quick methods for soil sampling and analysis for water-soluble salt content, both of which are critical for the downstream screening. With these easy-to-follow protocols, users can conduct analyses in a quick and effective manner.

Simple and quick methods are also provided to screen seedlings for salt tolerance in hydroponics. The seedling test takes 4–6 weeks and allows the screening of several hundred seedlings. The test can be used to screen segregating populations, standard lines and cultivars, as well as M_2 populations and advanced mutant generations. A list of the required equipment is given, along with setup procedures

for hydroponics hardware and stock solutions. Tolerance is determined by performance comparisons against known salt-tolerant genotypes. Control tests (without salt) can also be performed if required as an indicator that the system is working and for comparing growth under salt and non-salt conditions. Indicators of tolerance are leaf colour, leaf rolling, leaf tip dying, and seedling death. Root damage (growth and browning) and biomass can also be observed. The protocol was originally designed to screen rice mutant populations for salinity, but has been adapted for wheat and barley by the addition of aeration and increased salt concentrations. The protocol has been tested and validated on materials from Iran, Myanmar, and Vietnam.

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