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A new brew: tissue culture has boosted Indonesia's tea industry.

Tea is a matter of culture

Cloning techniques have enabled Indonesia to improve its tea industry, reports **Brad Collis**

The reach of modern agricultural science to even the most remote village farming systems has been starkly illustrated through the use of cloning to mass-produce tens of thousands of superior seedlings so that Indonesia can improve its tea plantations.

The need to upgrade with higher-yielding and disease-resistant varieties required a breeding program beyond the capacity of conventional techniques. With the help of an ACIAR-supported project, researchers have used in-vitro technologies to first develop then clone new varieties.

The issue arose because virtually all green tea in Indonesia, and 40 per cent of tea overall, is produced by smallholders – and smallholder plantations have only half the productivity of large estates. Also, many of the current varieties are susceptible to blister blight.

The Indonesian Government's plans to improve the industry needed 20,000 hectares of tea trees to be replanted each year, which was not feasible using conventional plant breeding techniques. There was, however, the potential to produce the very large numbers of superior plants required by using plant tissue culture.

This led to the project 'Development of in-vitro technologies for tea improvement in Indonesia' by the University of Queensland and Indonesia's Biotechnology Research Unit for Estate Crops. Project leader was Dr Bill Dodd.

The biotechnology phase was necessary to create both the diversity of superior lines and the large stock plantation within a short time. The micro-propagation research team looked at tissue culture media suited to tea plants. They used a broad spectrum approach where a large number of treatments were used to systematically test the role of different culture nutrients (for example inorganic ions, sucrose, vitamins) for both multiplication and root initiation.

Superior tissue-cultured material underwent rapid multiplication to establish a stock plantation of about 400,000 plants from which cuttings could be supplied for normal propagation.

To start the project, scientists began at the basics – studying the fundamental application of tissue culture techniques to the improvement of tea. After some work it was decided that although micro-propagation was feasible for both black tea and green tea clones, the best rates of multiplication achieved were only two-fold per month – useful for experimental purposes but not for a commercial system.

Efforts were then made to find ways to produce somatic embryos in tea, since somatic embryos potentially provide the basis of a technique for rapid propagation that can be automated, with low labour inputs compared to micro-propagation.

The project was extended, and in the second phase the scientists identified factors affecting embryo development in liquid culture systems, which would allow the process of embryo development to be controlled.

Researchers also investigated the factors involved in the commercialisation of the processes of somatic embryo and propagule production. Tea production in Indonesia is based on dryland agriculture, which means that tea plants are subject to moisture stress and loss of production in most years.

This means one advantage that seedling tea plants generally have over plants propagated from cuttings is a superior root system, which provides better drought tolerance.

However, an attribute of somatic embryos is they produce plants that have a shoot and root axis, which leads to the development of a strong taproot while having clonal attributes of uniformity and high productivity.

The project has since shown how to produce large numbers of the most suitable varieties from somatic embryos that grow into vigorous, fast-growing plantlets with a strong taproot.

The chief breeder at the Tea Research Institute in Indonesia believes these embryos will provide the best material for the future, and the stage is set to benefit large numbers of Indonesia's smallholder tea producers.

In addition to the development of the in-vitro process for tea, the project provided training at the Brisbane laboratory of Queensland University of Technology (QUT) for two Indonesian research workers.