Recent advances - cell culture in plant improvement

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Genetic manipulation using plant cell and tissue culture is likely to become an increasingly important adjunct to plant improvement. There are several compelling reasons for this.

Increasingly, economically important species are becoming more amenable to cell culture manipulation Proliferating cell lines can now be established for some of the important cereal species such as maize and wheat and for legumes such as lucerne. Plants can be regenerated in relatively large numbers from cell lines of these species.

The availability of a cell culture cycle permits selection at the cellular level. This has particular application to those characters where there is a correlation between cellular and whole plant response. An adequate correlation to permit cell selection has been established for agronomically-important traits such as disease resistance, salt tolerance, aluminium tolerance, some herbicide tolerances and possibly temperature tolerance. Cell selection has been effective in producing a wide array of biochemical mutants in plants. Some amino-acid analogue-resistant mutants over-produce specific amino-acids. This is a first step in upgrading nutritional quality of agronomic crops. Examples where cellular selection has given rise to potentially improved genotypes include disease resistance, salt and herbicide tolerance.

A recent, albeit unexpected, discovery is the occurrence of increased genetic variation among plants regenerated from cell culture (1). This phenomenon, which is called somaclonal variation, has been observed both in a diverse array of species and for a wide spectrum of characters, including those of agronomic importance. Somaclonal variants of potential value have been found in sugar cane (disease resistance, yield), (1, 2), potatoes (disease resistance, growth habit, tuber uniformity) (3), maize (disease resistance) (4), lucerne (yield) (5). Several new floricultural cultivars of Pelargonium and Begonia have been derived from somaclonal variants. Somaclonal variation has also been reported in rice, barley, onion, pineapple, oats, sorghum, lettuce and tomato.

Finally, cell culture is an important feature in developing the technology to effect genetic transformation in crop plants. Recombinant DNA research is providing the means for identifying, isolating and enzymatically recombining genes into molecular vectors. Plant cell and protoplast culture will provide the target cells and the selection regimes to recover vector-mediated, genetically transformed cells. The Division of Plant Industry has recently initiated a program which will attempt to apply these facets of plant biotechnology to the genetic improvement of wheat.

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