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Somatic embryogenesis for crop improvement

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SUMMARY

Conventional breeding and advances in agronomic and horticultural practices, most of the crops have attained close to their maximum yields. The manipulation of cell and tissue cultures to produce somatic embryos efficiently is one of the milestone of new technologies that will greatly alter the way crops are planted(as artificial seed) and genetically altered in the future. Gene transfer into embryogenic plant cells is already challenging conventional plant breeding and has become an indispensable tool for crop improvement. This review provides a current assessment of the impact of somatic embryogenesis in agriculture.

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With the increase in world population, the agricultural yield have often stagnated and even declined in some areas. In many parts of the world rural poverty has increased and the natural resource base has degraded. Conventional approach to modernization of agriculture on the principle of intensification through specialization (as in green revolution) has not adequately addressed these problems. During 1960's it has been realized that grain production of green revolution would not be sufficient to overcome because of increasing world population in the coming few decades. Therefore, development of alternate strategies for increasing plant productivity were considered to be of utmost importance. *In vitro* procedures for manipulating plant differentiation, growth and development, regeneration of plants from cell culture and protoplast isolation, culture and fusion were considered to be integral parts of this new technology. Cell culture coupled with molecular biology for crop improvement has been, referred to as the genetic engineering revolution.

One of the most important pre-requisite for genetic manipulation of plant is the regeneration of plants under aseptic condition on a culture medium from somatic cell, either *via* organogenesis (Christianson,1987) or somatic embryogenesis(Ammirato,1985;1987). In organogenesis root and shoot development are often mutually exclusive and a sequence of media changes is necessary to generate an entire plant. Since cell or tissue transforms are expensive in terms of material and personal time and increase the chance for contamination. Many researchers regard somatic embryogenesis as the *in vitro* system of choice for mass propagation of super and genetically engineered genotypes (Gupta *et al.*, 1991). Somatic embryogenesis has a number of advantages over other micropropagation techniques, namely axillary shoot proliferation and adventitious shoot production. The advantages most commonly cited includes very high multiplication rate and the potential for scale up in liquid culture (*i.e.* bioreactors) and for direct delivery to the green house or field as artificial seed (Markle *et al.*,1990). Such features make it likely that clonal propagules produced *via* somatic embryogenesis will have significantly low that clonal propagules produced using other micropropagation system due to lower labour costs. Further more, embryogenic cultures have also been shown to make excellent target material for gene transfer *via Agrobacterium* Ti plasmid mediated and biolistic transformation (Mc Granahans *et al.*, 1989; Parrot *et al.*,1988). Thus it is widely believed that embryogenic cultures will eventually be employed for commercial scale production of clonal propagules. The involvement of somatic embryogenesis as a modern tool for increasing agricultural productivity is the subject of this review.

What is somatic embryogenesis:

Since 1958 when the first plant embryos were obtained from somatic tissues of carrot (*Daucus carota*) cultured *in vitro* (Reinert, 1958; Steward, 1958) ever increasing number of species have been induced to form somatic embryos. Somatic embryos resembles their sexual counterparts and presumably the result from expression of genes regulating the same development pathway. They are bipolar structure having root and shoot apices.

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