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## Apomixis and crop improvement

Apomixis is a phenomenon, by which plant species produce seeds without sex. Common among wild species, it is possibly a nature-devised strategy in some to preserve and perpetuate their identity and derive the advantage of associated adaptability in a given environment. This phenomenon of clonal production of seed operating through development of embryo either directly from the somatic cell of the surrounding maternal nucellar tissue (adventitious embryony) or from an unreduced egg in embryo sac derived from nuclear cell (apospory) or from mitotic division of the megaspore mother cell (diplospory) offers unique opportunities in the improvement of crop plants, where the phenomenon is rare. Among the advantages, development of true breeding hybrids is of great economic significance. In the era of hybrid technology across crop plants, the major constraints to its natural spread, in spite of impressive yield advantage and better stability of agronomic performance over diverse environments, are higher seed cost and burden of replacing seed every season, unlike inbred varieties, wherein produce from successive crops can be used as seed. Research efforts to breed in the apomictic phenomenon into crop plants, especially self-pollinated ones like rice have not succeeded as yet on account of technical hurdles and slow pace of research on one hand and apprehension of the private seed industry that the technology would prove a threat to its business interests on the other. The slow pace of research has been largely due to over emphasis on the approach of adventitious embryony (twin seedling approach) for long. Thanks to accelerated research underway in several laboratories to evolve and use alternate approaches, which include (i) transfer of apomict genes found in related wild species by taking advantage of cell-tissue culture techniques as demonstrated possible in the transfer of the gene from *Tripsacum* to maize (Savidon, 1996) and *Pennisetum* sp. to pearl-millet (Dujadin and Hanna, 1989), (ii) identification, cloning and transfer of apomict gene(s) from distantly related or unrelated species with the aid of recombinant DNA technique and (iii) induction of mutations affecting the specific stage of seed development in the test systems like *Arabidopsis* or yeast, that would trigger embryo development before megaspore mother cell enters meiotic cycle. Splicing of such mutant gene(s) by gene transfer technology holds lot of promise. Research leads already available in this regard at the CSIRO, and CAMBIA (Australia), are likely to make apomixis a reality sooner than expected in a variety of crop plants. India, with adequate scientific manpower is competent enough to join this global venture and contribute substantially, provided there is will to invest and spirit to work as a team in a complementary fashion. While embarking on such exploratory research the scientific community should, however, remain fully alive to apprehensions on normal development of endosperm in cereal crops, no-opportunity for generation of variability in an obligate apomict and on the perceived danger of 'terminator technology' that is bound to defeat the very purpose for which the strategy of apomixis is being contemplated in our innovative crop breeding pursuit. Maheshwari *et al.* (**page 1141**) address the issue of engineering apomixis in crops.

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## Virtual chemistry

Chemistry is undoubtedly an experimental science. Smelly laboratories, filled with dirty tables, crowded with glassware are readily associated with chemistry. Increasingly, however, chemistry is acquiring a cleaner (if not greener) image. There are a growing number of chemists whose experiments are performed in a virtual laboratory. Computer simulations replace the 'real thing'. For many, fulfillment is achieved in front of graphics terminals. The great impact of theoretical research on the practice of 'real chemistry' was recognized by this year's Nobel award to John Pople and Walter Kohn. The power of modern computational chemistry cannot be underestimated. It is the tools of quantum chemistry that Gadre and Pingale (**page 1162**) bring to bear on the problem of understanding hydration patterns in crown ethers, a class of compounds serendipitously discovered by Charles Pederson at Du Pont in the early 1960s, which were at the forefront of the development of the areas of molecular recognition and supramolecular chemistry. The 'crowns' are simple molecules with appropriately positioned oxygen atoms that hungrily await metal ions for coordination. Uncomplexed crown ethers in aqueous surroundings readily settle for water, resulting in structurally well-defined hydrates. The authors ask if electrostatics-based theoretical methods can be effectively used to predict patterns of hydration. Mapping molecular electrostatic potential yields a charge topography of the molecule, which is then used to generate 'lock and key' fits of the substrate and water.

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