WOZNIAK, CHRIS A., USDA, Agricultural Research Service, Northern Crop Science Laboratory, Fargo, ND 58105. Progress in the development of transgenic sugarbeets.

The introduction of foreign DNA into *Beta vulgaris* L. through genetic engineering has been actively pursued since 1984. When contrasted with other crop species, sugarbeet has been considered recalcitrant to standard plant transformation techniques. Despite many successes in the production of transgenic cells and tissues, with some whole-plant regenerants, routine genotype-independent transformation has long been elusive. Protocols based upon *Agrobacterium tumefaciens* have been applied successfully to produce transgenic lines for breeding programs, largely in the industrial arena. Due to the proprietary nature of much of the work, details of protocols with their successes and failures are often unknown. Although transformation frequencies have been very low, sufficient numbers of herbicide tolerant plants have been produced to test their utility in field trials. Positional integration of the introduced DNA has effects on transgene expression and has led to the term positype to refer to genotypically identical plants that vary in phenotype based upon location of the transgene. Positypes have been selected which are herbicide tolerant and have good yield quality characteristics. Recent advances based on the isolation of mitogenic, totipotent guard cell protoplasts and PEG-mediated introduction of DNA (R.D. Hall *et al.*, Nat. Biotechnol.14:1133, 1996) suggest a promising avenue for a higher frequency of transformation that appears to be less genotype dependent. In addition, transformation via microprojectile bombardment has also been successfully demonstrated with the introduction of defense-related and cytokinin regulating genes (G. Snyder, A. Smigocki, USDA-ARS). The use of viral coat protein expression in transgenic sugarbeets has been documented for the control of beet necrotic yellow vein virus (M. Mannerlöf *et al.*, Euphyt. 90:293, 1996) and progress is also being made toward development of curly top virus resistant plants. Antibacterial (*e.g.*, cecropin) and antifungal (*e.g.*, chitinase, glucanase, thionin) proteins are similarly being recruited as part of a modified plant defense response. The recent cloning of the first nematode resistance gene, *Hs1*$^{pro-1}$, and its demonstrated ability to encode resistance in hairy root cultures, will provide a way of combating the beet cyst nematode, *Heterodera schactii,* through transgenesis (Cai *et al.*, Sci.275:832, 1997). To date, little information on insect resistance mechanisms in transgenic sugarbeets is available and this leaves a void for the near future in terms of pest management through transgenesis. Novel selection mechanisms, such as mannose positive growth selection of cells expressing the phosphomannose isomerase gene (*pmi*) from *E. coli,* have enhanced transformation efficiencies two to three-fold (F.Okkels, DLF-Trifolium). As transformation protocols become more routine, they will no doubt broaden the scope of sugarbeet engineering and result in value added traits, such as enhanced sucrose content and the synthesis of biodegradable polymers, that are presently being developed for modification of other crops. Tolerance to the herbicides glufosinate and glyphosate will be the transgenic phenotypes most likely to reach commercial production first; these transgenics could reach seed release in 1998 in the U.S.. Both sociopolitical and regulatory concerns will no doubt influence the use of genetically engineered sugarbeets and their application and timing will, therefore, vary in different countries. Gene transfer between wild *Beta* spp. and sugarbeet has already been demonstrated in Europe following bolting of plants in commercial fields. This avenue for release of transgenes into natural populations is a concern with respect to development of new weed types and the dilution of natural genetic diversity. A glyphosate tolerant fodder beet has been entered in official trials (Denmark, 1996) and is expected to be listed in 1998 throughout the EU. The actual handling and distribution of transgenic foodstuffs is a source of heated debate at this time, particularly in Europe. Previous release of genetically engineered cotton, maize, potato, squash and tomato following their deregulation and approval may help pave the way for transgenic sugarbeet use in the U.S.