SPECIAL SYMPOSIUM—2001 CSSA MEETING (Charlotte)

The papers that follow were presented on 23 Oct. 2001 at a symposium “Transgenic Pest-Resistant Crops: Status and Testing Issues” at the annual ASA-CSSA-SSA Meeting. The symposium was sponsored by divisions C-1, Crop Breeding, Genetics, and Cytology; C-3, Crop Ecology, Management, and Quality; A-4, Extension Education; and A-8, Integrated Agricultural Systems. The symposium’s objectives were to explore the challenges in cultivar evaluation and the potential difficulties in communicating comparative information about cultivar performance in cultivar evaluation programs with both transgenic and nontransgenic cultivars. Since the commercial transgenic cultivars have been modified specifically to express pest-managing traits, the symposium focused on issues regarding evaluation of these types of transgenic cultivars.

Transgenic cultivars are now the dominant soybean [Glycine max (L.) Merr.] cultivars in worldwide production and international commerce. Similarly, transgenic corn (Zea mays L.) and cotton (Gossypium hirsutum L.) cultivars are very commonly grown in the major cotton- and corn-producing countries. Transgenic canola (Brassica napus L.) cultivars occupy more than half the crop hectarage in North America; transgenic rice (Oryza sativa L.) was commercially introduced in 2002; and transgenic wheat (Triticum aestivum L.) is under development. Thus, for all the major grain and grain-legume crops except sorghum [Sorghum bicolor (L.) Moench], transgenic and nontransgenic cultivars need to be, or will soon need to be, compared agronomically and economically. In fact, in soybean and cotton, the term conventional cultivar may soon have an ambiguous meaning, as the great majority of cultivars in commercial production, in development as candidate cultivars and in experimental lines, are transgenic.

Most of these transgenic cultivars share a common characteristic; that is, the inserted gene or genes express a pest-managing trait or traits. Thus, the cultivar is a dual-purpose product. It not only provides yield and an expected package of quality traits, but it also provides part of its own pest defense, in a sense extended beyond that traditionally understood to result from classical host plant resistance breeding. The value of the transgenic pest-managing cultivars includes not only the plant that produces the commodity, but also certain means of pest protection that would otherwise be purchased and managed separately by growers. Moreover, although the gene is a constituent of the cultivar’s genotype, in most cases, the use of the transgenic expression is leased to the grower for one season by means of an annual contract. Comparing the seed and crop production industries today and two decades ago, it is clear that commercialization of the first generation of transgenic cultivars is changing the structure of the seed and crop protection product industries, the relationship between seed supplier and grower, the number and types of cultivars that are available, and the price of seed relative to that of other variable crop production input costs. These changes have also impacted the research community and those responsible for conveying crop production information to growers.

There has been strong interest in the agronomic evaluation of the transgenic cultivars. In most instances, the transgenic cultivars represent modifications of previously released cultivars. Questions have arisen concerning expectations for their agronomic performance. Were they agronomically equivalent to their backcross parents, or did they represent agronomic advancement? We note three major challenges to cultivar evaluation, among others.

**Number and nature of introductions.** Although there are relatively fewer seed companies, more cultivars are being commercially introduced; in some major agronomic crops, the great majority of these are transgenic. The new transgenic cultivars have frequently been multiple, near-isogenic reselects of previously released cultivars.

**Longevity of cultivars in evaluation and commerce.** In recent years, many transgenic cultivars have been introduced and withdrawn from commercial sales within a relatively short span (e.g., 3–5 yr), and few transgenic cultivars have been available for precommercial evaluation by third parties for 3 yr before commercial sale, a period that formerly was considered the minimum period required before inclusion in lists of cultivars recommended by public research institutions.

**Potential for confounded effects in evaluation protocols.** A transgenic, pest-managing cultivar embodies both the agronomic means to produce the commodity and part of the pest management necessary in production. When evaluating cultivars, the effects of a transgenic cultivar’s agronomic and pest management attributes must be considered both independently and collectively. Such evaluation is typically beyond the scope of traditional cultivar testing programs. In a trial conducted with uniform pest management, there is no comparison of pest management efficacy among cultivars of different types; and the validity of such agronomic comparisons depends on the absence of a significant interaction between the agronomic and pest management attributes, a condition that is more frequently assumed than experimentally confirmed. Moreover, the economic value of the cultivar depends on the aggregate effect of all attributes. Implied economic comparisons of transgenic pest-managing cultivars based on trials employing uniform pest management assume that a difference in the main effect of pest management is not important to the value of the cultivar—a concept inconsistent with transgenic cultivars’ commercial purpose and appeal. Conversely, transgenic cultivars that provide outstanding pest management but that do not provide competitive yields or crop quality may appear as false economies.