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ESA Position Statement on Transgenic Insect-Resistant Crops

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Potential Benefits and Hazards

The Entomological Society of America (ESA) advocates the following positions on the uses of genetic engineering in crop production.

Key Points

- Genetically engineered crops that express insect-pest resistance traits could facilitate a shift away from the reliance on broad-spectrum insecticides and toward biological-based pest management.
- Numerous mechanisms exist by which transgenic plants may reduce insecticide use, including engineered resistance to insect-vectored viruses. Further improvements in molecular technologies will expand our capabilities to develop single or multiple pest-resistant plants.
- Transgenic plants that produce insecticidal substances are and should continue to be subject to careful testing to ensure safety and minimize environmental risks.
- Insect-resistant crops should be deployed according to scientifically based, resistance-management plans to prevent the evolution of genetically adapted insect strains.
- The use of insect-resistant plants is not equally appropriate for all crops in all agricultural systems. Therefore, a case-by-case scientific analysis of risks and benefits should be conducted before commercial use.

Continuing the Need for Safe, Cost-Effective Insect Controls

Although significant efforts have been focused on improving pest control concepts and technologies in the past 30 years, we are often unable to control insect and mite pests in an environmentally benign manner. Increased use of cultural and biological pest control tactics will be instrumental in developing ecologically sound pest management strategies. Insecticides are currently a primary tool for controlling insect pests are frequently incompatible with such tactics.

Genetic Engineering Increases Pest Management Options

Historically, the use of pest-resistant plant varieties has decreased pesticide use and has been a key component of many integrated pest management programs because of its compatibility with biological and cultural control tactics. New biotechnologies have expanded our capabilities to introduce pest resistance traits into plants and offer the potential to further reduce pesticide use.

Human Health Considerations

Transgenic crops are subjected to regulatory scrutiny that is similar to that of pesticides, including tests for detrimental health effects. Humans have already been exposed to some proteins similar to those that will be produced by transgenic crops. For example, insect-specific proteins from the bacterium, *Bacillus thuringiensis* (Bt), that are now expressed in transgenic corn, cotton, and potatoes, have been used in crop protection for more than 20 years without adverse health effects. Additionally, crops are being protected from insect-vectored viruses by transgenic production of viral proteins that already are found commonly in foods. Although no health hazards are expected from transgenic crops that are currently under development, all appropriate tests should be applied to assure public safety.

Environmental Impacts

Because insect-resistant transgenic plants are intended to control pests, it is likely that they will directly reduce broad spectrum pesticide use. In many cases, this reduction will result in higher densities of natural enemies, providing enhanced, biological control impacts. In some systems, decreased pesticide use could allow previously inconsequential pests to increase in number and take on a previously unrecognized pest status.

Topically applied pesticides land on weeds inside the crop and can drift to surrounding vegetation where they may suppress non-pest species. Because transgenic plants produce pesticidal compounds only within their cells, these non-target effects are eliminated. Some non-target herbivores and detritivores that utilize transgenic plants as a food source may be affected by the internally produced insecticidal compounds. Therefore, as with conventional pesticides, an evaluation of the impacts of gene products and their breakdown constituents on non-target organisms currently forms part of the regulatory review process.

The large-scale release of insect-resistant transgenic crops must be preceded by studies that determine the potential for weediness or for outcrossing to weedy relatives. Most of the crops currently targeted for commercial release are unlikely to become weedy in the United States, based on the introduction of pest resistance. Regardless, the release of transgenic plants into environments where weedy relatives exist should be carefully assessed. The incorporation of insect resistance into self-seeding or perennial crops in which resistance could alter the crop's ecological niche should be evaluated with detailed environmental impact studies to determine if release is appropriate. Useful germplasm released in this country is likely to be planted in other countries, so concern for environmental safety extends beyond U.S. borders.

Insect Resistance to Transgenic Plants

The evolution of resistance in insects and mites has been a common problem for insecticides and plant varieties with single-gene resistance. Furthermore, resistance to *Bt* toxins has developed in field populations of the diamondback moth in response to repeated use of *Bt* sprays. To prevent insects from developing resistance to transgenic plants, resistance-prevention tactics should be devised before pest-resistant crops are widely and intensively deployed.

Managing Resistance

The fundamentals of resistance management that apply to pesticides also pertain to transgenic plants. Transgenic plants, especially those that produce toxins throughout the season, could bring with them difficult challenges not experienced with externally applied insecticides. Alternatively, this unique delivery system may provide new opportunities for delaying or managing resistance development. Management strategies should be developed that take advantage of the ability to manipulate the spatial arrangement of transgenic plants, thereby incorporating refuges for susceptible insects into the cropping environment. Increased knowledge and expertise in insect and plant biology will lead to new genes that can be combined in crop plants to provide additional barriers to resistance development. Other more sophisticated tactics such as tissue-specific, temporal, or inducible gene expression may also provide alternative resistance management tools.

The wisdom gained from previous pesticide failures should provide impetus for the proactive development and implementation of management strategies for transgenic crops. While it is currently premature to identify the most practical and effective tactics, a general framework exists for successful resistance management with transgenic plants. As with pest management in general, resistance management programs can be improved and refined as better information and tools become available.

The farm-level implementation of resistance management will face practical and social obstacles. Ensuring that good management practices are utilized is a challenge that will require commitment and coordination from industry, academia, government, and individual growers.

Transgenic Plants as Elements of Agro-ecosystems

Pest and natural enemy population dynamics are affected by numerous, interacting ecological factors. In some systems, use of a minor crop with insect resistance could eliminate a key ecological resource that allowed pest populations to reach high densities in major crops. In other cases, transgenic control of a pest in one crop could limit the food source of important natural enemies and lead to increased pest problems. There is a continuing need for interaction between ecologists, geneticists, and plant breeders in determining system-wide impacts and devising optimal ways of deploying insect-resistant crops.

Criteria for the Release of Transgenic Plants

The usefulness of transgenic plants must be considered in spite of the potential for resistance development. However, we must recognize that transgenic insect resistance is not an appropriate pest management approach for all crops in all agricultural systems. For example, prophylactic control is not generally called for in areas where targeted pests only have sporadic outbreaks or in cases where safe, self-sustaining, biological control agents can maintain pests below economic thresholds.

The wisdom of using a specific insect-resistant crop should be evaluated relative to the long-term goals of reducing pesticide use and fostering sustainable crop production systems.

The challenge facing entomologists and pest managers is to ensure that these crop varieties are used properly and that scientific information remains a cornerstone of debate regarding their deployment.

The Entomological Society of America is the largest organization in the world serving the professional and scientific needs of entomologists and people in related disciplines. Founded in 1889, ESA today has more than 7,000 members worldwide affiliated with educational institutions, health agencies, private industry, and government. Members, many of whom utilize collections directly or indirectly but all of whom understand their importance, include researchers, teachers, extension educators, administrators, marketing representatives, research technicians, consultants, students, and hobbyists. For more information, visit http://www.entsoc.org.