The Debate about Non-Bt-Corn Refuges Continues

As almost everyone involved in agriculture knows by now, the use of Bt-corn for management of European corn borers and southwestern corn borers has increased for its year of introduction through 1998, when an estimated 15 million acres of Bt-corn were planted in the United States. Some industry experts expect that within 5 years, Bt-corn will be planted on more than 50 percent of the nation’s 80 million corn acres. Everyone also knows that resistance-management strategies need to be implemented if we expect to prolong the durability of Bt-corn technology. The resistance-management strategy agreed upon by most experts is the high dose/refuge strategy. The intent is that a high dose of the Bt Cry protein expressed in corn plants will kill all corn borer larvae with no genes for resistance (ss), as well as those with one copy of a resistance gene (rs). Refuges are intended to provide a source of corn borers that are not exposed to Bt-corn or Bt insecticides, and these moths would be susceptible (ss) to Bt. The large numbers of Bt-susceptible moths emerging from non-Bt refuges would be available for mating with the assumed rare Bt-resistant (rr) moths, thereby producing only small numbers of corn borer moths heterozygous for resistance (rs). It is assumed that survival of resistant heterozygotes is low.

Almost all scientists in the seed and chemical industries and at universities agree that the high dose/refuge resistance management strategy is the best way of preserving Bt-corn as a useful pest management tool. However, a debate about the amount and arrangement of non-Bt-corn refuges started with the emergence of this new technology, and the debate continues.

In 1997, members of NC-205 (a regional research committee supported by land-grant universities, USDA–CSREES and –ARS) published North Central Regional Extension Publication NCR 602, Bt-Corn & European Corn Borer: Long-Term Success Through Resistance Management, edited by K. R. Ostlie, W. D. Hutchison, and R. L. Hellmich. This well-written and well-illustrated publication explains in an easy-to-understand manner the use of Bt-corn for management of corn borers. One of its key features is a discussion of practical deployment of non-Bt-corn refuges for resistance management. The authors agreed to the following recommendation: “Plant non-Bt-corn refuge(s) to protect 20–30% of the European corn borer larval populations from exposure to Bt Cry proteins. Plant corn at a similar time and in close proximity to Bt-corn. In corn–soybean production areas, where corn is the primary refuge, at least 20–30% of the corn acreage should be non-Bt-corn. Where spraying of non-Bt-corn is anticipated, increase the refuge size to 40%.” An electronic version of this publication, with the preceding and several other recommendations, is located at http://www.extension.umn.edu/Documents/D/C/DC7055.html.

More recently, NC-205 has prepared a detailed supplement to NCR-602. One reason for developing this supplement was to address some companies’ suggestions that the amount of unsprayed refuge can be as low as 10%, and
that the amount of refuge should be increased to 20% if control of corn borers with chemical insecticides is anticipated. In the NCR-602 supplement, the committee members express the following key points:

- Recent data based on samples from three localities support a key assumption that major resistance genes are rare.

- Recent data on non-random mating and regional genetic structure of European corn borer, coupled with new theoretical models, suggest that a 20% refuge is the minimum needed for resistance management.

- Economic analyses suggest corn growers can benefit from planting refuges.

- A refuge of 20–30% of the larval population of European corn borer can be achieved by planting 20–30% of the corn on a farm to unsprayed non-Bt-corn. This area should increase to 40% if the refuge is sprayed with insecticides. The non-Bt-corn refuge should be planted within each 320-acre area that has Bt-corn, at a similar time and with similar maturity characteristics as the nearby Bt-corn.

The entire 12-page document, including 10 bullet points in an “Executive Summary” and almost 40 references, is located at http://ent.agri.umn.edu/ecb/nc205doc.htm.

Obviously, scientists within the industry and university and USDA scientists have not reached consensus about the amount of refuge required to make high dose/refuge resistance-management strategies work. The reason they do not agree is easy to explain. The percent of non-Bt-corn refuge to plant for resistance management is based upon the use of theoretical models, which are developed based on certain assumptions. Depending upon the assumptions used to drive the models, the results can vary. Consequently, if people use different assumptions to develop their models, the outcomes may differ rather significantly. Ergo, different recommendations from different perspectives.

In light of these different opinions about the amount of non-Bt-corn refuge to plant, how does a producer know which opinion (both based upon similar science) is correct? No one really knows, based upon empirical evidence, what the right amount of non-Bt-corn refuge should be. One could argue that we may never know. Therefore, we urge producers to weigh all scientific evidence and explanations of such evidence when they are considering planting Bt-corn for management of corn borers. The bottom line is this: Planting a refuge of non-Bt-corn is extremely important if we want to preserve the technology and demonstrate stewardship. We still believe that our guideline of planting a minimum of 25% non-Bt-corn refuge is reasonable. Whether chemical treatment of 25% refuge is allowable is debatable. From a practical standpoint, we imagine that serious infestations of non-Bt-corn refuges will be treated. However, regardless of how you plan to manage a non-Bt-corn refuge, planting a refuge (25% non-Bt-corn) is the most important first step.

Stay tuned for future developments. As more research is conducted and analyzed and as new transgenic products reach the market, resistance management strategies likely will evolve.

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CONFERENCE CONNECTION

Don’t Forget to Register for the 1999 Crop Protection Technology Conference

Don’t forget to register for the Crop Protection Technology Conference (formerly known as the Agricultural Pesticides Conference, the old “Spray School”) scheduled for January 6 and 7, 1999. This year’s program planning committee has delivered what promises to be an exciting array of speakers and topics. The 1999 program will begin with a keynote session on “Agricultural Biotechnology.”

Following the keynote portion of the program, a diverse panel representing many agricultural interests will respond to questions from the media regarding a video created by the National Coalition on Drift Minimization. Other portions of the program on the first day include speakers who will offer insights on the continuing problem with rootworms in first-year corn and the use of transgenic insecticidal cultivars for control of corn rootworms. Many weed science presentations also will be given during the first day by out-of-state speakers from Iowa State University, Purdue University, Michigan State University, and the University of Wisconsin.

During the second day, four distinct and challenging sessions will be offered addressing the following areas: plant pathology, precision agriculture and on-farm research, fertility and water quality, and the Food Quality and Protection Act. The second day will conclude with the always popular session entitled “New Developments from Industry.”

About 11.2 hours of Certified Crop Adviser (CCA) credits will be offered for this conference, in the following categories: crop production (0.8 hour), pest management (8.9 hours), and soil and water (1.5 hours). If you wish to preregister, please complete and return the enclosed form by December 18, 1998. Preregistration is $80; walk-in registration will be $95. As a reminder, all who register will receive one copy each of the 1999 Illinois Agricultural Pest Management Handbook and the Proceedings of the Crop Protection Technology Conference. Additional copies of these publications may be purchased at the conference.

On behalf of the program planning committee and University of Illinois
1999 Illinois Crop Protection Technology Conference
Preregistration Form

Please mail completed preregistration form(s), or fax to (217)333-9561, by December 18, 1998. Call (217)333-2881 to register by phone. On-line registration is possible through the World Wide Web at (http://www.conted.uiuc.edu/ci/icptc).

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Program Highlights

Wednesday Morning, January 6
• Keynote Session: Agricultural Biotechnology, A Revolution!
• Minimizing Pesticide Drift: National Coalition on Drift Minimization Video and Panel Discussion

Wednesday Afternoon, January 6
• Corn Rootworm: Status Report on the Latest Research Findings
• Weed Science: Emerging Issues

Thursday Morning, January 7
• Plant Pathology: Emerging Issues
• Precision Agriculture and On-Farm Research
• Fertility and Water Quality Issues

Thursday Afternoon, January 7
• Food Quality and Protection Act
• New Developments from Industry

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