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ONE EXTENSION ENTOMOLOGIST'S PERSPECTIVE ON BT TRANSGENIC CORN

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Introduction

The title is very important. It is my opinion based on what I now know about Bt corn. I say NOW because this technology is on a very fast track and new information is added almost daily. From a gene deployment and resistance management point of view of Bt corn, there are many, many unknowns. All of us are learning on the go.

The data base on the technology is growing rapidly, however. The cooperation of the seed industry with university scientists for purposes of sharing ideas and seeking information has been outstanding.

I have organized my comments in this way: Speak briefly to the role of an extension entomologist, speak to the pest (European corn borer on corn) and currently available management technology, including Bt transgenic corn, and finish with some suggestions of incorporating the Bt transgenic technology into an overall management strategy for corn production.

I. The role of the extension person dates back to the Morrill Act in the early 1900's and its relationship with the land Grant University mission of teaching, research and extension. I see my role of an Extension Entomologist as a synthesizer and deliverer of research findings to the interested public.

I AM an advocate of disseminating authenticated information and good and solid education.
I AM NOT an advocate of the Bt technology over any other European corn borer management alternative.

II. The European corn borer is a serious pest of several crops and can survive on many different plants in the United States east of the Rocky Mountains. In the Midwest, these crops include corn, sorghum, oats, millet, potatoes, beans, peppers, etc. The insect attacks several weed species as well. In Nebraska, our surveys indicate the majority of growers feel like they have serious borer problems about 2 - 3 years out of five. Almost a third of the growers feel like they experience as much as a 10% loss in yield in those years when they see damage. Yet the majority of producers do not use an insecticide to attempt control. I can only speculate they think management alternatives such as insecticide use do not offer an economic return. Producers may not trust themselves on how to scout nor make treatment decisions. On the other hand, surveys taken in Nebraska during 1991-92-94 indicate approximately 2.0, 1.9 and 1.8 million acres of corn, respectively, were treated with an insecticide to control European corn borer in corn.

III. In no specific order, I offer the following list of management options currently available to the producer to reduce damage by the European corn borer: I believe these options are important in the context of a discussion about Bt transgenic corn since I also believe the successful implementation and longevity of Bt transgenic corn hinges on the integration of all these options into an overall long term management strategy.
1. Planting date/days to maturity ranges
2. Insecticides
   - larvicides
   - adulticides
3. Native resistance
4. Parasites & predators
5. Bt transgenic corn

PLANTING DATE and MATURITY RANGE is important in the context of crop phenology synchronizing with moth flight and oviposition during the season - when synchrony is near perfect, the potential of borer damage is highest. For example, the tallest corn is most attractive to first generation egg deposition and varieties pollinating during second generation moth flight are most vulnerable to second generation egg deposition. Although I do not suggest that potential European corn borer damage drive planting dates, there are economic advantages to spreading your risks by selecting a number of different varieties by maturity groups in order to attempt to capture the best climatic conditions of the cropping season in terms of planting conditions, summer rainfall patterns, temperature ranges during pollination, harvesting conditions, etc. By default, the sequence of planting dates over time automatically result in differences of crop phenology over time. The bottom line is that the time spread of phenology differences superimposed over moth flight, results in that all fields are NOT equally vulnerable. This is an important area of understanding as producers look at risk.

Based on our surveys, NATIVE RESISTANCE against European corn borer is rarely considered in variety selection. This is despite the fact that differences in larval survival across varieties during the whorl stage can be as much as 3 to 4 fold. Our data suggests that native resistance during the whorl stage of corn can limit survival and damage to less than 1 larval cavity per plant in scenarios that include heavy infestations. Native resistance differences among hybrids seems to be less pronounced in reproductive stage corn and second generation damage. There are some differences, however, that warrant consideration when selecting hybrids.

PARASITES and PREDATORS are important in the context of the mix of population regulators. Their annual impact varies and they currently are not the answer for a control strategy. Nonetheless, in Nebraska, our surveys indicate mortality by parasitism is as high as 25% in some years but significantly less than that in most years. My point is that recognition of the value of these insects is important.

INSECTICIDES play the major role in control. I understand the reality of the range of percentage reductions achieved by insecticide applications on a commercial basis and the resulting dissatisfaction in some instances. But I do not subscribe to the common theory that we cannot successfully and economically control second generation European corn borer with insecticides. We have the research base in application technology and the insecticides to satisfactorily control both generations of European corn borer. This is clearly the case with first generation and with some dispute for second generation. I could give you a number of validations if I had more time.

BT TRANSGENIC CORN technology is phenomenal and speculation is that the transgenic concept may be the major strategy of pest management in the future. I am, and sure you are also, aware of the diversity of opinion about genetic engineering - witness the action recently by an organization against the idea and their destruction of some field plots near Atlantic, IA. I continue to hear conflicting information regarding the acceptance of genetically altered grain on the world market. It will take time to resolve these issues.

My experience over the last three years in evaluating the performance of many of the Bt events targeted at the European corn borer and transformed into commercial corn varieties has convinced me that the control is outstanding albeit there are significant differences in efficacy across events with the control of second generation borer larvae. Performance is variable against other foliar insect pests of corn and issues of “pest status
replacements" looms as the ecology of the cornfield changes with the presence of Bt corn and the elimination of foliar insecticides applied to control European corn borer larvae.

I am just conservative enough, however, to want to wait to see what happens and for a validation of corn borer control after some years of commercial use. I have no reason to believe, however, that commercial control will not match the control observed in small plot trials (note the 1996 scenario with Bt cotton in Texas).

I share the concern of many others about the potential of the European corn borer to become resistant. There is intense dialogue about the potential for resistance and there are strong differences of opinion. My question is threefold: 1) will resistance happen, 2) when, and 3) what resistance management program(s) will delay or prevent resistance. I again take the conservative approach and assume resistance will occur in the absence of resistant management programs. Although several resistant management programs have been suggested, none have been validated on a commercial scale.

IV. My thoughts and perspectives regarding purchasing and planting of Bt transgenic corn hybrids, with the understanding that I continually seek new perspectives that may alter these comments, include the following:

1. Choose the most adaptable hybrid that offers the greatest yield and profit for your operation. Look at all important traits. Considerations should include maturity, standability, root size, rate of drydown, harvestable yield, insect and disease resistance, response to plant populations, etc., and all other plant characteristics important to your management. Secure an extensive data base across many environments when seeking yield data.

2. Initiate a scouting protocol of annually determining the degree of European corn borer damage in all cornfields. Build this data base over years and correlate damage with location, variety, maturity, planting date, insecticide use, etc.

3. Bt transgenic corn hybrids identified with YieldGard™ express the Bt endotoxin in all plant tissues. These hybrids provide a very high degree of control against damage by first and second generation European corn borer larvae throughout the season.

4. Bt transgenic corn hybrids identified either with Maximizer™ with Knockout™ or NatureGard™ with Bt-derived resistance express the endotoxin in green tissue and pollen. These hybrids provide a very high degree of control against damage by first generation borer. Control of second generation borer is variable but should compare favorably with that achieved by a conventional insecticide application. This variability in control is due, in part, to the lack of expression of the endotoxin in the ear and an apparent decline in the concentration of the endotoxin as the plant approaches senescence.

    NOTE: The key of "control" is in protecting the plant and preserving physiological yield (ear size) from second generation European corn borer damage during the vulnerable early reproductive stages. Damage and the presence of larvae after the blister stage has minimal or no effect on ear size. Yield is the better indicator of control or protection.

    How each of these two very different approaches of endotoxin expression eventually impacts potential resistance and resistance management is not currently known.

5. Compare the yield potential of the Bt hybrid with the yield potential of the corn hybrids you presently grow. Economic infestations of corn borer will not occur every year.
6. Compare the cost of Bt transgenic hybrid seedcorn to your annual average cost and effectiveness of insecticide use and/or the cost of the estimated annual damage caused by the European corn borer.

7. Bt transgenic corn hybrids have a place in areas of high European corn borer incidence and where crop phenology as a result of planting date and maturity indicates a strong potential of synchrony of vulnerable crop stages during peak moth flight and egg laying. This usually includes the use of long season hybrids and significantly early or late plantings. Significantly late plantings may represent the greater overall risk and, therefore, more likely to be the first consideration for a Bt transgenic hybrid.

8. Read and understand the label that accompanies the Bt transgenic seedcorn bag. Pay special attention to items of information that relate to insect and insect damage monitoring and resistance management. Comply with all recommended resistance management recommendations.

9. Generally speaking, Bt transgenic hybrids are effective against European corn borer larvae, southwestern corn borer larvae, and have some effect of reducing damage by armyworm and corn earworm. All other common insect pests of corn are not controlled.

10. DO NOT plant all your corn acreage to Bt transgenic hybrids.

11. Allocate time to keep up with new information regarding the Bt transgenic corn technology. New and improved transgenic hybrids over greater maturity ranges will continually be introduced into the marketplace.