28. Insect Resistant Field Corn (1)

The European corn borer (ECB) is an introduced insect species. It probably arrived in North America during the early 1900s in corn imported from Hungary and Italy for the manufacture of brooms. As full grown larvae, European corn borers spend the winter in corn stalks, corn cobs, weed stems or in a spun-silk covering located in plant debris. For field corn, yield losses from ECB larvae are primarily physiological losses from reduced plant growth. Stalk tunneling results in shorter plants with fewer and smaller leaves. Movement of water and nutrients can be restricted over the entire kernel-filling period. During whorl stage of corn growth, there is between 5 and 6% loss in grain yield for each larva per plant. During the corn development stage, the loss per larva per plant is about 2 to 4%. The USDA issued annual reports for 1942–1974, in which estimates were made of the yearly corn production losses from European corn borer damage. The annual losses varied from a low of 33 million bushels (1952) to over 300 million bushels per year (1949, 1971).

The southwestern corn borer (SWCB) was originally described from a specimen collected in Mexico in 1911. The first official records of the presence of the southwestern corn borer in the United States are in 1913. A native of Mexico, being of tropical origin, it thrives in warm weather, but has difficulty surviving the winter in northern areas. This is in contrast to the European corn borer, which being of European origins, is more tolerant to colder weather. First-generation larvae feed in the whorl until they are large enough to tunnel into the stalk. Second-generation larvae feed in the leaf sheath and between the husk leaves of primary ears when small. Larvae migrate down the plant, tunnel into the stalk near the base and begin construction of a hibernation tunnel. This “girdling” of the stalk in the early fall can result in severe lodging. Plants that snap off completely may be impossible to harvest. Grain yield losses of up to 29% in plants infested with first and second generation larvae were recorded.

Beginning in 1996, several seed companies commercially introduced new corn hybrids that had been altered genetically to produce a Bt protein toxic to corn borers. Research has demonstrated that the SWCB is as susceptible to Bt corn as the ECB. Larvae survival is very low on all transgenic hybrids. As part of the process of reregistering the Bt corn varieties, EPA estimated the aggregate benefits to US growers of planting Bt corn. EPA estimated aggregate benefits compared to corn not treated with insecticides to range from $38 million in a year of low borer pressure to $219 million in a year of high borer infestation. Numerous studies have estimated the increases in corn yields due to Bt corn adoption since 1997. These studies’ results have been largely determined by the extremely low population of the ECB in Midwestern states (1998 – 2000). However, many entomologists regard the years 1998 – 2000 as extremely unusual and not typical of long-term normal ECB populations which began to increase in 2001.

A survey of extension service entomologists was undertaken for information on corn yield impacts due to ECB/SWCB infestations during a ‘low’ and a ‘high’ infestation year. In order to estimate the Bt corn price premium paid by US farmers, two companies supplying Bt corn seed were contacted. The cost of the Bt technology is estimated at $6.50/A. The use of insecticides is simulated on Bt corn acreage for a high infestation year. Of the 36 main corn-producing states, there are only three states (AL, IN, MS) for which an insecticide application during a high year would not cover the cost of the insecticide treatment. In a high year, growers only gain from Bt corn the extra 20% yield improvement that they would not gain from using insecticides. Bt corn is credited with lowering production costs during a high infestation year because Bt corn costs less than insecticides. In a low infestation year, Bt corn is credited with stopping yield losses to borers.

Impacts of Insect Resistant Transgenic Field Corn (1)

| Change in production volume: | +3.5 billion lbs/yr |
| Change in net income:       | $125 million/yr    |
| Change in pesticide use:    | 2.6 million lbs/yr reduction |

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An Analysis of 40 Case Studies by Leonard P. Gianessi Cressida S. Silvers, Sujatha Sankula and Janet Carpenter
National Center for Food and Agricultural Policy, June 2002.
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