A Critique of:

An Appraisal of EPA's Assessment of the Benefits of Bt Crops

by
Dr. Charles M. Benbrook
October 17, 2000
Prepared for
Union of Concerned Scientists

This Critique is authored by Leonard P. Gianessi

National Center for Food and Agricultural Policy
1616 P Street, NW
Washington, DC 20036
Phone: 202-328-5048 Fax: 202-328-5133
ncfap@ncfap.org

October 31, 2000

Introduction

On October 20, 2000, the Union of Concerned Scientists submitted to EPA a report prepared by Dr. Charles Benbrook analyzing EPA's assessment of the benefits of Bt crops. Subsequently, the Benbrook report has been posted on the internet: www.biotech-info.net

The Benbrook report discusses the benefits of Bt field corn, Bt sweet corn and Bt cotton, with most of the discussion focused on Bt field corn. Benbrook concludes that although Bt field corn increases yields, these yield increases are modest and could be achieved easily by alternative techniques. He presents an analysis that is claimed clearly "to refute" EPA's conclusion that Bt corn has reduced insecticide use. His bottom line is that with relatively modest benefits, the relatively modest risks of Bt corn should tip the risk/benefit scales against the continued registration of Bt corn.

Summary of Critique

1. Benbrook concedes that, on average, Bt corn has improved yields and net returns. He argues that this is modest. 1998-2000 were years of very light insect pressure and low corn yields, and still, positive benefits were achieved. Many growers benefited far above the average. In heavy infestation years the benefits will be much larger. With corn farmers in economic distress, a technology that improves the bottom line should not be dismissed.
2. The "alternative methods" that Benbrook touts are not new. They have been researched for 70 years. Farmers do not use them because they are extremely complicated, time consuming, would require extensive changes in farming practices and are not as effective as Bt corn.
3. Benbrook's manipulation of pesticide use data to show an increase in insecticide use for the European corn borer is arbitrary and unconvincing. He leaves out of

his analysis the one insecticide that clearly went down in use because of Bt corn. The insecticides that went up in use are not used for European corn borer (ECB) control. They are used almost exclusively for other pests. No entomologist or survey supports his hypothesis. The available surveys support the EPA conclusion that Bt corn caused a reduction in insecticide use.

<u>Bt Corn</u>

Benbrook claims that European corn borer management options are available. He asserts that ECB populations only reach damaging levels a few years out of every ten. Actually, the opposite is true. ECB populations are at damaging levels most years out of ten. Benbrook asserts that corn growers have been managing the ECB adequately most years without Bt corn. This is not accurate. Survey data from Iowa State University indicate that most corn growers were not managing the ECB at all. Their strategy was to do nothing and suffer the yield losses. Some harvested early to minimize losses to ECB, that can cause plants to "lodge" or fall to the ground and become unharvestable.

Benbrook asserts that additional ECB control options are available for corn growers to use. He cites research at Ohio State University where researchers have studied ECB populations on organic farms in comparison with neighboring conventional farms. Benbrook reports that the Ohio State research suggests that differences in nutrient management results in less damage from ECB on the organic farm. Benbrook incorrectly interprets the Ohio State research as to the reason for less damage. Benbrook asserts that conventional farms with standard nutrient applications do not develop adequate defense mechanisms against the ECB. He suggests that organic corn develops defense mechanisms through more effective use of slower-releasing nutrients from manures and other organic types of nutrients. Actually, the Ohio State research suggests that it is precisely that conventional corn is so much faster growing, resulting in more sugars and amino acids in the greener leaves, that attracts more ECB females that lay their eggs preferentially in the healthier corn. The organic corn is slower-growing and less attractive. Benbrook's misinterpretation results in a convoluted conclusion that organic plants must be emitting some as-yet-undiscovered chemical signal that repels or discourages ECB feeding. Is Benbrook suggesting that it is acceptable to have some undiscovered, unknown, untested chemical repellant in the organic food supply?

Benbrook incorrectly refers to the Ohio State researcher who conducted that research, Larry Phelan, as an agronomist. Dr. Phelan is an entomologist.

Benbrook asserts that there are several known management strategies to suppress ECB populations, including nutrient management, planting shorter season corn, chopping up stalks in the winter, planting cover crops, etc. All of these were available and had been studied long before Bt corn became available. Benbrook notes that the Ohio organic farm operations were described over a decade ago in an NAS report. These other systems have not been adopted widely because they have limited effectiveness and are much more complicated to implement. Farmers make decisions on types of tillage practices, nutrient practices and when to plant based on many factors other than simply insect control. The simplicity and effectiveness of Bt corn is the reason that growers have adopted this technology. There has been no shortage of studies regarding alternative means of controlling the ECB. This pest represents the single largest effort by the U.S. government to discover or develop biological controls. All of the biological solutions to this pest problem (researched over the last 70 years) have had limited or no impact on the ECB.

Finally, Benbrook asserts that crop rotation is a "proven" control measure. This is totally inaccurate. There are no studies to support this. The ECB is highly mobile and flies between rotated and non-rotated fields.

Benbrook uses tough language to describe research and technology that produce only modest improvements in crop yields. He suggests that society and agriculture might be better served by having the Bt corn researchers working on other problems. The same line of reasoning might be used to assess the performance of the considerable research effort regarding "alternative agriculture" over the past decade. What positive net benefits have they delivered? Where is the cost-benefit ratio concerning the Leopold Center, a sustainable agriculture research center in Iowa?

Benbrook claims that insecticide use for the ECB actually increased following the introduction of Bt corn. He cites no surveys of farmers who say that they have increased their insecticide use for ECB. He cites no university entomologists who share his view. The available surveys of farmers show just the opposite. According to Iowa State University surveys, insecticide usage among Bt corn farmers is declining. In 1996, insecticide use declined 13% with Bt corn farmers. In 1997 and 1998, 19% and 26% of Bt corn farmers stated a reduction in insecticide use from previous years.

Benbrook's logic in explaining why corn farmers increased spraying for the ECB is two fold.

(1) Growers have been sensitized to the importance of ECB control because of all the attention focused on Bt corn. While this is a correct statement, Benbrook argues that some have decided that rather than planting Bt corn they would spray an insecticide. This makes no sense. Benbrook claims that the cost of the Bt seed is an extra $10 an acre; the cost of a single insecticide spray for ECB control is $14 an acre. Growers are advised to expect from 67% to 80% control of the ECB by spraying. Bt corn gives 95% control. Why would a farmer decide to spray instead of planting Bt corn? Benbrook ignores all of the reasons that growers traditionally have not sprayed, including the difficulty of scouting and timing treatments. These problems have not disappeared. The decision to spray is not as simple as Benbrook implies. However, the decision to use Bt corn is simple. Given this increased interest in ECB control and Benbrook’s assertion that alternative non-chemical methods are cost effective, why have the growers not selected a non-chemical method instead of spraying?

(2) Benbrook also claims that beneficial insects may have shifted in importance because of Bt corn. There is no evidence to support this claim at all.

The data that Benbrook manipulates to support his ideas come from USDA NASS surveys of corn growers 1995-1999. Since the NASS data do not identify the target pest in the surveys, Benbrook makes his own assignments. He misattributes all of the spraying of lambdacyhalothrin, dimethoate and esfenvalerate to ECB. These pesticides are recommended for many insect pests in corn, including cutworm, stalk borers, leaf aphids, adult rootworm beetles, European corn borer, armyworm, grasshoppers and mites. There is no justification to assign all of their use to ECB. In fact, it is very likely that the increased use of these compounds is largely the result of increased in-season sprays for cutworms. Benbrook assigns 25% of the increase in fipronil and bifenthrin to ECB control, with the remainder going to rootworm control. Bifenthrin is used primarily for mite control and not ECB. Fipronil was recommended in 1999 for rootworm and grubs. There is no mention in the University Extension publications for 1999 of ECB control with fipronil. Benbrook arbitrarily assigns 25% of its use to ECB control.

Benbrook leaves one key insecticide out of his analysis of trends: foliar Bt, that was used on 1% of the nation's corn acreage in 1995 and is no longer recorded as being used following the introduction of Bt corn. Why apply Bt foliarly when it is in the plant? Some farmers who report a decline in use of insecticides following the introduction of Bt corn undoubtedly were spraying Bt in the early 1990's.

Benbrook does not consider the likely impact of his recommendation that EPA cancel the use of Bt corn. He is correct in stating that growers have become sensitized to the potential damage from the European corn borer. Many growers have been ignoring the damage from ECB for many years and not spraying. Now they are planting Bt corn and seeing the positive impact on yields. What happens if Benbrook's advice is followed, and Bt corn is taken away? It is quite likely that insecticide use would increase dramatically as some growers start spraying.

Benbrook grudgingly concedes that with respect to corn yields that actual data on the performance of Bt corn lends "partial" support to the conclusion that planting Bt corn has increased corn yields. However, to put this yield advantage in perspective, Benbrook cites studies where no differences in yield were estimated. However, the studies that he cites were conducted before the widespread introduction of Bt corn and are merely simulations based on historic ECB populations. Benbrook cites entomologists who clearly advised growers to think long and hard about the potential benefits of Bt corn for 2000 based on the light infestations seen in 1998 and 1999. Their advice was only plant Bt corn if your experience over time indicates that you are likely to have a damaging population. This is sound advice. Thus, the real question is who planted Bt corn and what did they gain by planting it? Averages can be very misleading. Data from Marlin Rice at Iowa State University indicate that benefits are not uniform. For example, in 1999, 21% of the side-by-side comparisons in Iowa indicated a yield advantage for Bt corn of nine bushels per acre while the remaining 79% indicated no advantage. In 1997, 40% of the comparisons indicated an increased yield advantage of 18 bushels per acre for Bt corn while the remaining 60% produced no advantage. There are growers who have made significant gains from planting Bt corn. Three factors must be kept in mind in evaluating Bt corn's effectiveness:

(1) It's early in the adoption cycle. Many growers may try out a technology to see how it works. They may stop using it if it does not produce significant benefits.

(2) Many growers may be willing to pay the premium for Bt corn seed simply for its insurance value. In case it is a bad outbreak year, they are protected.

(3) 1998/1999/2000 were very unusual years in that ECB populations were so low. A10 or 15 year time horizon may be needed to evaluate the technology fully.

Benbrook states that 1997 was a high infestation year. He is incorrect; 1997 was an average or slightly low infestation year. In a high infestation year the advantage of Bt corn could be as high as 40 bushels per acre.

Benbrook suggests that a positive net return of $3.31 per acre from Bt corn is modest and not important. He needs to be reminded of the extremely low returns that corn farmers have experienced these past few years. The $3.31 net return estimate is based on a Bt corn fee of $10 per acre. In actuality, the Bt corn fee has come down significantly and is probably closer to $7 per acre on average, that, essentially, would double the calculation of economic benefit of Bt corn to corn farmers.

Bt Sweet Corn

Benbrook reports that the planting of Bt sweet corn has been limited due to the unwillingness of shippers to accept the genetically engineered crop. He suggests that there might not be a huge reduction in insecticide spraying for sweet corn in Florida because of the emergence of the silkfly, that he asserts accounts for one-half of the insecticide use in the crop. This is an unsupported assertion. A University of Florida researcher presented data to EPA based on experiments in 1998 and 1999, documenting a reduction from as many as 19 sprays in the conventional sweet corn to 3 in the Bt sweet corn. Benbrook simply asserts that the silkfly is the result of intense spraying for other insects. There is no evidence for this, but if it were the case, would not reduced insecticide spraying in Bt sweet corn also result in more predators attacking the silkfly and perhaps further pesticide use reduction? Indeed, the University of Florida researcher presented data for the EPA Science Advisory Panel that showed that the numbers of predators and parasitic insects and spiders were all higher in the Bt sweet corn plots.

Benbrook bemoans the discontinuance of the insect resistance breeding program for sweet corn in the 1970's. His implication is that further work with conventional breeding may have reduced the need for insecticides or for Bt sweet corn. This is not supportable. Sweet corn breeders have been focused on flavor and yield, and they have done a great job. What assurance can Benbrook provide that an insect resistant, conventionally bred sweet corn cultivar will also taste great? Keep in mind that the Bt sweet corn is insect resistant, high yielding and tastes great.

Benbrook mistakenly refers to methomyl as an organophosphate; methomyl is a carbamate.

Bt Cotton

Benbrook reports that EPA estimated a reduction of 7.5 million acre treatments in cotton as a result of Bt cotton, but he tries to put that reduction in perspective by suggesting that it may not hold up over time due to changes in pest populations, resistance, etc.

One value of Bt cotton is that it takes much of the pest resistance pressure from traditional insecticides for control of the bollworm/budworm complex (BBW) , consequently prolonging their usefulness for other pests in cotton fields. Bt cotton is just another control technique for managing a complex set of pest problems in cotton. One sure way to help improve resistance management to Bt cotton would be register more insecticides for cotton and keep currently registered insecticides available for cotton growers to use. One strong concern that Benbrook did not mention is that EPA may cancel many of the insecticides that cotton farmers use and put so much selection pressure on the remaining insecticides and on Bt cotton that resistance will appear more quickly.

He suggests that much of the reduction may not be due to Bt cotton because it initially occurred in 1996, following a heavy outbreak year in 1995. Bt cotton was introduced in 1996 and was planted widely in several states immediately (77% of Alabama's cotton acreage). Sprays in Alabama for BBW went from 6.7 in 1995 to 0.1 in 1996. Bt cotton was responsible for this reduction. 1995 was a bad outbreak year because the chemicals were not effective enough.

Benbrook manipulates NASS pesticide use survey data to try and associate certain chemicals with control of bollworm and budworm. He then asserts that based on his assignments, insecticide use for BBW actually increased in certain states (such as Alabama) from 1997 to 1999.

He misattributes insecticides to BBW control. For example, the increase in Alabama is due to increased applications of aldicarb, a pesticide not targeted at bollworm/budworm, but one whose increased use in Southeastern states' cotton is accounted for largely by nematodes. Benbrook assigns tebufenozide and carbofuran as BBW insecticides; tebufenozide and carbofuran received emergency registrations for use against armyworms and aphids, respectively. There is no need for Benbrook to make the target pest assignments because cotton entomologists do such assignments every year, and the results are published in the National Cotton Council's Proceedings of the Beltwide Cotton Conferences. According to the Cotton Council's reports, in every state, sprays for BBW were reduced following the introduction of Bt cotton. Sprays for the BBW in Alabama did not double between 1997 and 1999, as Benbrook's manipulations suggest. Rather, the National Cotton Council's estimates are that between 1997 and 1999, there was a 20% reduction in sprays for the BBW in Alabama.

Benbrook tries to put the reduction of cotton insecticide use in Arizona in perspective by suggesting that it may be due in large part to the introduction of new, effective insecticides for control of the sweet potato whitefly and not Bt cotton. There is no denying the positive impact of the new insecticides, but to give credit where credit is due, it is instructive, once again, to examine the National Cotton Council's estimates. For Arizona in 1999, conventional cotton growers sprayed once for bollworm; Bt cotton growers did not spray at all for the pest.