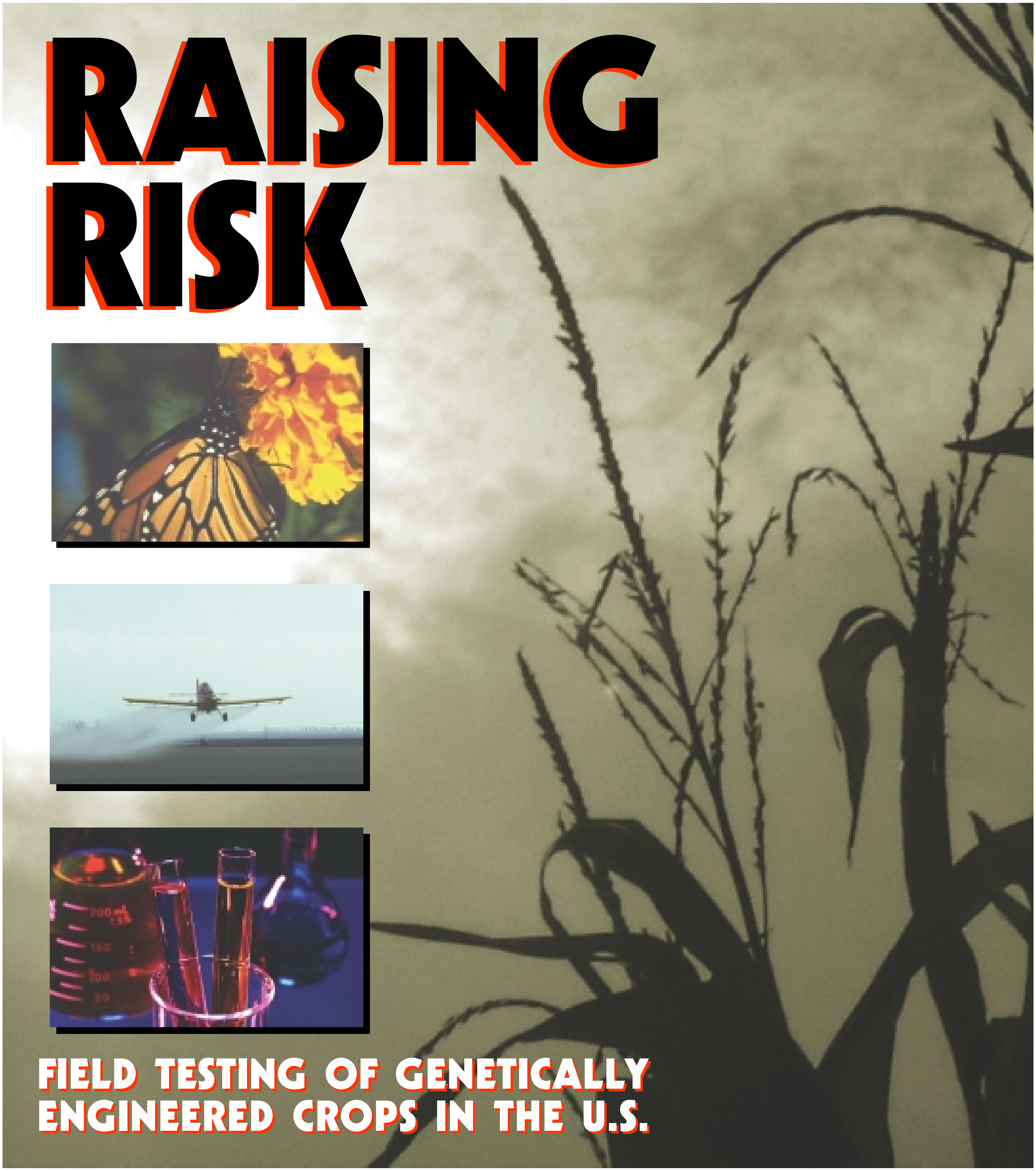
RAISING RISK



FIELD TESTING OF GENETICALLY ENGINEERED CROPS IN THE U.S.

NATIONAL ASSOCIATION OF
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GENETICALLY ENGINEERED FOOD ALERT
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FIELD TESTING OF GENETICALLY ENGINEERED CROPS IN THE U.S.

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U.S. Public Interest Research Group is the national lobbying office for the National Association of State PIRGs. The State PIRGs are non-profit, non-partisan public interest watchdog organizations.

The State PIRGs are founding members of Genetically Engineered Food Alert, a national coalition of more than 200 organizations, scientists, chefs, and others concerned about the impact of genetic engineering on our food supply and environment.

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Genetic engineering raises a host of ecological and human health concerns that have not been adequately addressed.

EXECUTIVE SUMMARY

The science of genetic engineering, particularly as applied to agriculture, is radical and new. Never before in the history of the planet have we been able to transfer genes across natural species barriers, creating unheard of combinations like tomatoes with fish genes, or even pigs with human genes. Contrary to popular belief, the technology is not very precise. Scientists cannot control the location where the gene is inserted into the host's genetic code, nor guarantee stable expression of the gene in the new genetically engineered organism. As a result, genetic engineering raises a host of ecological and human health concerns that have not been adequately addressed. Despite this, on tens of thousands of acres across the United States, although the exact amount is not publicly available, experiments with genetically engineered crops are being conducted in the open environment with little oversight and public notification.

When the science of genetic engineering began in the 1970s, the National Institutes of Health (NIH) said experiments that released genetically engineered organisms into the environment were too hazardous and should not be performed. Despite these early calls for caution, a booming biotechnology industry soon turned its eyes to agriculture, and field experiments applying genetic engineering to plants were allowed to begin in the 1980s. Based on available data, this report documents the extent of field testing of genetically engineered crops across the United States, highlights the environmental risks, and details the lack of regulation.

Field tests of genetically engineered crops are supposed to be conducted in an attempt to both determine the impact of the new crops on the environment, and to determine how well the plants function. But there are many potential risks associated with the release of genetically engineered plants. For example, introducing nonnative organisms into the environment can cause degradation of natural ecosystem functions, and is estimated to cost the United States alone an estimated $123 billion annually. Plants engineered to produce proteins with insecticidal properties may damage the soil, or harm so-called nontarget species like the monarch butterfly. Plants engineered to be virus resistant can cause new viral strains to evolve through recombination, or make existing viruses more severe. And if field experiments are not properly monitored, genetic pollution can result, putting farmers' livelihoods and the environment at risk. Thus our environment is serving as the laboratory for widespread experimentation of genetically engineered organisms with profound risks that, once released, can never be recalled.

USDA's regulations on field tests, which still form the basis of the agency's oversight although they have been considerably weakened, were inadequate from the start. An independent analysis by the General Accounting Office in 1988 roundly criticized shortcomings in the regulations, echoing calls by prominent microbiologists, ecologists, and others that certain decisions were "scientifically indefensible." USDA has continued to considerably weaken its oversight of the technology despite little empirical evidence on which to base such decisions. The agency has failed to require adequate data collection of field tests of genetically engineered crops, leaving the true impacts of these new creations still largely unknown. According to a review that was conducted of the 85 most recent reports of field tests available in 1995 (before oversight was further weakened), some of the most fundamental tests necessary to determine ecological impact, such as experiments to assess weediness or impacts on nontarget insects, were never even conducted. As the authors of the report concluded, this is a classic example of a "don't look, don't find" regulatory framework.

Key Report Findings

Raising Risk examines data regarding field tests of genetically engineered crops and the environmental risks associated with these tests. It also examines the evolution and adequacy of USDA's regulations on genetic engineering. It is clear that USDA has generally served as a rubber stamp for applications to conduct field tests. Only 4% of applications to conduct field testing have been rejected, and those that have been rejected were for reasons such as incomplete applications or other minor paperwork errors. Other major findings include:

- USDA authorized 28,892 field test sites of genetically engineered organisms through 2000.
- As of January 2001, the ten states and territories that have hosted the most field test sites are: Hawaii (3,275), Illinois (2,832), Iowa (2,820), Puerto Rico (2,296), California (1,435), Idaho (1,060), Minnesota (1,055), Nebraska (971), Wisconsin (918), and Indiana (886).
- As of January 2001, 9 states and territories have hosted ten or fewer field test sites. They are Nevada (0), New Hampshire (0), Vermont (0), Virgin Islands (0), Rhode Island (3), Alaska (5), Utah (6), Massachusetts (7), and West Virginia (10).
- The range for the remaining states is between 20 and 830.
- The universities submitting the most requests for permits are University of Idaho (78), Iowa State (68), Rutgers (65), and University of Kentucky (50).
- From 1987 through 2000 inclusive, Monsanto (or a now wholly-owned subsidiary) applied to conduct the most field tests every year.
- In a snapshot of the rapid industry consolidation among companies investing in genetically engineered crops, of the top 10 institutions applying to conduct field tests in 1995, 7 have now merged into 2 companies (Monsanto and DuPont).
- The percentage of field tests being conducted with introduced genes considered to be "Confidential Business Information" has increased nearly every year, from 0% in 1987 to 65.4% in 2000.

Recommendations

Although nearly 29,000 field tests of genetically engineered organisms have been conducted under USDA's system, fundamental questions about this technology have not been adequately answered. Frequently, in fact, the information we learn about the subject raises serious concerns about its implications. The impacts on human health from consuming these products and on the environment from their release have not been fully explored. Nor have fundamental social and ethical questions, and all of these issues must be dealt with before further large-scale experimentation commences.

In order to make progress towards these goals, U.S. PIRG recommends a moratorium on the field testing and commercialization of genetically engineered foods and crops unless:

1) ***Independent safety testing demonstrates they have no harmful effects on human health or the environment;***

2) ***The public's right to know about field tests is improved and any products commercialized are labeled; and***

3) ***The biotechnology corporations that manufacture them are held responsible for any harm.***

Introducing nonnative organisms into the environment can cause degradation of natural ecosystem functions and loss of biodiversity.

INTRODUCTION

The science of genetic engineering is radical and new. The first recombinant deoxyribonucleic acid (DNA) molecules were generated at Stanford University in 1972.[1] Never before were scientists able to isolate fragments of DNA from one organism and join it with DNA from a completely different organism. As the techniques were extended, unheard of combinations could be created, such as tomatoes with fish genes, potatoes with mouse genes, apples with chicken genes, and even pigs with human genes.[2] Contrary to popular belief, the technology is not very precise. Scientists cannot control the location where the gene is inserted into the host's genetic code, nor guarantee stable expression of the gene in the new genetically engineered organism. As a result, genetic engineering raises a host of ecological and human health concerns that have thus far not been adequately addressed.

When the science of recombinant DNA began in the 1970s, the National Institutes of Health (NIH) said in a 1976 set of research guidelines that experiments releasing genetically engineered organisms into the environment were too hazardous and should not be performed. Despite these early calls for precaution, a booming biotechnology industry soon turned its eyes to agriculture, and field experiments applying genetic engineering to plants were allowed to begin in the 1980s. Based on available data, this report documents the extent of field testing of genetically engineered crops across the United States, highlights the environmental risks, and details the lack of regulation.

Field tests of genetically engineered crops are supposed to be conducted in an attempt to both determine the impact of the new crops on the environment, and to determine how well the plants function. But there are many potential risks associated with the release of genetically engineered plants. Introducing nonnative organisms into the environment can cause degradation of natural ecosystem functions and loss of biodiversity. It is estimated that invasive species already cost the United States alone an estimated $123 billion annually.[3] Recent studies have raised real concerns about the impact of genetically engineered crops on soil ecosystems as well as so-called nontarget species such as the monarch butterfly from plants engineered to produce proteins with insecticidal properties. Plants engineered to be virus resistant can cause new viral strains to evolve through recombination, or make existing viruses more severe. Thus our environment is serving as the laboratory for widespread experimentation of genetically engineered organisms with profound risks that, once released, can never be recalled.

Oversight of genetically engineered crops was largely in the hands of NIH through the first decade of development. President Reagan's White House, as a result of a legal challenge from a public interest group,[4] established an interagency task force in April 1984 to study and coordinate the government's regulatory policy for products of genetic engineering. Many agencies were involved,[5] and the proposal for a Coordinated Framework for Regulation of Biotechnology was published New Year's Eve 1984.[6] The Framework was the outline for how government agencies with oversight over genetic engineering would work together. Under the notice, agencies have complementary and often overlapping responsibilities for oversight of the technology. While other reports have addressed some of the shortcomings in the Framework for the Environmental Protection Agency (EPA)[7] and the Food and Drug Administration (FDA),[8] this paper focuses on oversight at the Department of Agriculture (USDA), and how the agency has allowed an enormous amount of experimentation under their jurisdiction to occur with inadequate oversight.

We have allowed genetically engineered crops to be grown widely with almost no precautions.

DATA ON FIELD TESTS

Introduction

Currently, thousands of field tests of genetically engineered organisms are taking place all over the United States. The health and environmental risks of genetically engineered crops have not been thoroughly tested, and yet in nearly all 50 states these experiments take place in the open environment. Further, concerns related to widespread genetic pollution, impacts on nontarget species, and the contamination of nearby plants are not adequately addressed under the current regulatory regime. Field tests are supposed to be done both to determine whether or not the desired effects achieved in a laboratory setting are replicable when grown in the field, and to assess the potential environmental impacts of these crops. Yet we have allowed genetically engineered crops to be grown widely with almost no precautions.

The field testing of genetically engineered crops is overseen by the Animal and Plant Health Inspection Service (APHIS), a division of the USDA. The primary and almost exclusive role of APHIS with respect to genetically engineered crops is to determine whether they are "plant pests" under the federal Plant Pest Act. The act defines a plant pest as anything that poses a risk or a threat to a plant. Genetically engineered plants are considered at risk of being plant pests if: (1) the donor organism from which the engineered gene comes from, (2) the recipient organism (usually a crop plant), or (3) the vector used for the genetic engineering is regulated. Thus, for example, if a gene from a group of organisms that are considered to be plant pests is introduced into a plant that is not considered a plant pest, APHIS would regulate the resulting plant as a potential plant pest. Based upon the results of field trials, however, those seeking to commercialize genetically engineered crops can petition for deregulation under the Plant Pest Act. The Department of Agriculture has never rejected a petition for deregulation. A more detailed explanation and analysis of the evolution of the regulations that APHIS has put forward are described in the chapter, *Analysis of USDA Oversight*.

Number of field releases and field sites

Two key concepts to understand in APHIS's regulation of field experiments are "field releases" and "field sites." When an institution petitions APHIS to conduct a field experiment of a genetically engineered crop, they are asking to conduct a field release. But if the institution wants to conduct several experiments of the same crop in different locations, each location is called a field site. For example, Permit # 97-259-01 is for genetically engineered corn to be grown at field sites in Hawaii and Illinois, two distinct and dissimilar ecosystems, but it counts as one field release.

Between 1987 and 2000, APHIS received a total of 6,820 requests for field test releases (See Appendix A). Some of these (478) were either withdrawn, denied, or voided. Over the same time period, APHIS authorized 28,892 field test sites under the same procedures (See Appendix C). These numbers include a small amount of organisms other than plants, such as genetically engineered microorganisms. In 1987, USDA acknowledged five field test sites, and in 1990 there were 81. In 2000 there were a total of 4,549 field test sites, a 56-fold increase in just ten years. The number of field test sites has increased nearly every year since 1987.

Until 1992, USDA only allowed field releases of genetically engineered organisms under a permitting procedure, but that was changed to allow tests of certain species under a streamlined notification system in 1993. In 1993, after six years of having 100% of the field releases conducted under the permit system, 62% (189) were conducted under the notification system. By 1999 and 2000, the percentage of field test releases under the notification procedure was above 96%.

The story is generally the same with field test sites, with one notable exception. In 1993 36% of field test sites were conducted under notification, and the number grew to more than 99% in 1998. However in 1999 and 2000, approximately 76% of field test sites were conducted under the notification system, a considerable drop. There are several reasons for this, including the creation of new crops that have novel phenotypic properties. For example, there is an increased interest in growing crops that produce pharmaceutical proteins or using visual marker genes that make crops fluorescent. The major reason, however, is that USDA has encouraged certain institutions that are field testing corn to apply under the permitting system rather than the notification system, because the agency claims to be very familiar with the tests and can process a large number of them together with less paperwork.[9]

As of January 2001, the ten states and territories that have hosted the most field test sites are: Hawaii (3,275), Illinois (2,832), Iowa (2,820), Puerto Rico (2,296), California (1,435), Idaho (1,060), Minnesota (1,055), Nebraska (971), Wisconsin (918), and Indiana (886) (See Appendix A). Nine states and territories have, since the beginning of USDA's regulations, hosted ten or fewer field test sites. They are Nevada (0), New Hampshire (0), Vermont (0), Virgin Islands (0), Rhode Island (3), Alaska (5), Utah (6), Massachusetts (7), and West Virginia (10). The range for the remaining states is between 20 and 830.

Information about the amount of acreage of field tests in general, as well as field test acreage data by state, is difficult to ascertain because USDA does not make all such information publicly available. In addition, if a field test was authorized by USDA for 50 acres in 5 states, there is no way to know if each state had a 10 acre test, if one state had a 2 acre test and the other 4 states had a 12 acre test, etc. U.S. PIRG analyzed all permits, and created an average value by allocating an equal acreage for each state (so in the above example, we assumed each state had a 10 acre test). We also summed the total number of permits for which no acreage is provided. The results are in Appendix D. Also included in Appendix D is a list of the most frequent crops field tested, categorized by state.

In Appendix E is a list of the most frequent crops field tested in the United States totaled nationally. Overall, the most commonly tested crops are: corn, potato, soybean, tomato, and cotton. Several crops have just begun to be tested, and have had less than five field tests since 1987, such as coffee, eggplant, onion, and pineapple.

Consolidation of institutions requesting permits

Concentration within the agricultural biotechnology industry has proceeded at an alarming rate. Included in Appendix B is a list of which institutions applied under either permit or notification procedures for field releases. From 1987 through 2000 inclusive, Monsanto (or a wholly-owned subsidiary) applied for the most permits/notifications every year. Since 1995, of the top 10 institutions applying for permits/notifications, 7 have now merged into 2 companies: Monsanto and DuPont. In addition, the universities submitting the most requests for permits are the University of Idaho, Iowa State University, Rutgers University, and the University of Kentucky.

There has been an alarming rapidity of concentration within the agricultural biotechnology industry.

The speed at which the industry has consolidated is evident from a closer examination of the major companies submitting requests for permits or notifications in 1995. In that year the institution submitting the largest number of requests was Monsanto, with 143. Monsanto recently "merged" with Pharmacia & Upjohn to create a company called Pharmacia, with Monsanto remaining an autonomous subsidiary self-described as "one of the largest and fastest growing companies in the agricultural sector."[10] Monsanto is currently the world's second largest seed seller, and the world's third largest seller of agrochemicals.[11] Since 1995, they have bought the companies ranked 5th, 7th, 8th, and 9th in that year.[12] Also in 1995, the institution ranked 2nd with 98 requests was DuPont, currently the world's largest seed seller and the world's fourth largest seller of agrochemicals.[13] In 1999, DuPont merged with Pioneer Hi-Bred, creating what the DuPont CEO called, "the most powerful agricultural technology force in the world."[14] Pioneer Hi-Bred was ranked 3rd in 1995 in terms of companies submitting requests.

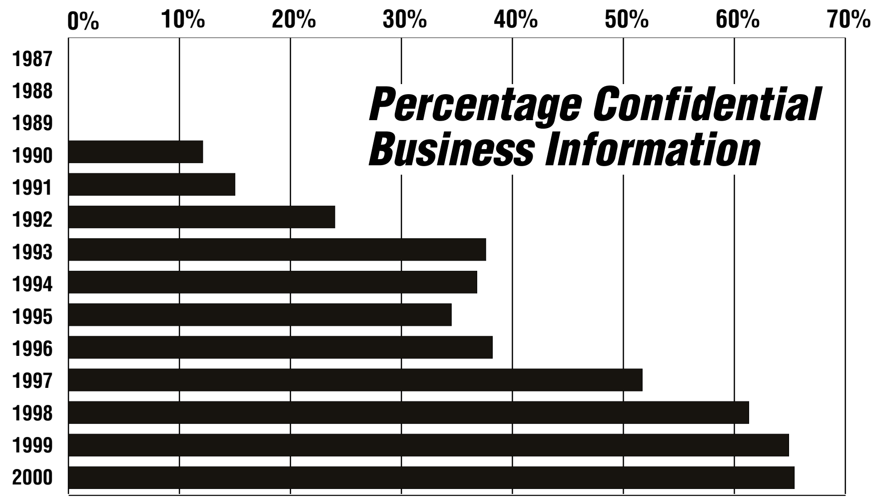
Frequency of permit denials

Between 1987 and 1993, USDA did not reject a single permit application for a field test of a genetically engineered crop. The pattern of allowing nearly every request to go forward continues; through 2000, only 4% of permits and/or notifications have been denied by USDA (Appendix A). According to APHIS, perhaps the only reason a submission is ever rejected is for minor, paperwork violations, such as incomplete applications.[15] When asked to do so, USDA has ruled in every case that genetically engineered crops deserve a "Finding of No Significant Impact," a determination that the plant will not have a significant impact on the quality of the human environment nor will the plant pose a risk of becoming a plant pest. [16]

Confidential Business Information of introduced genes

Between 1987 and 1989, all field tests of genetically engineered organisms in USDA's database contain introduced genes that are publicly disclosed. But from 1989 through 1999, the percentage of crops containing genes declared "Confidential Business Information" increased nearly every year, from 0% in 1989 to 65.4% in 2000. It is not only private corporations that are failing to disclose critical information regarding field experiments. Universities are also shutting out the public from knowing what new creations are being introduced into the environment. For example, Permit #s 99-029-01R and

99-028-01R are for 18 and 20 release locations respectively, yet the gene transferred to the host plant is not publicly available. Novartis's genetically engineered corn, Permit # 99-032-02, was grown in 26 locations around the United States and Puerto Rico, yet news about the introduced gene is Confidential Business Information. U.S. PIRG analyzed the results of 6,334 approved field releases; the results are in Appendix F.



Overview of methodology

For this report, data on field trials came from three separate but complementary sources. The first is from the Information Systems for Biotechnology (ISB) Web site maintained at Virginia Tech University. ISB is funded on an annual basis through a renewable grant to the Agricultural Experiment Station at Virginia Tech, and this service is available on the web at www.nbiap.vt.edu/cfdocs/fieldtests1.cfm. Several charts and tables are available (although it is frequently impossible to do a search broken down by a time period selected by the user), and very limited information is available about individual genetically engineered plants. In addition, a great deal of information is classified as Confidential Business Information, and thus inaccessible to the public, as discussed above. Selections of this data are found in Appendix A. The second is a special data request performed by Virginia Tech for the author, received in January 2001. This identifies the institutions submitting requests for field tests, broken down by year. This information is found in Appendix B. The third is data obtained by the author directly from APHIS in January 2001. This information includes the number of requests for field tests broken down by whether they were requested under notification or permit procedures, indicating the data requirements expected from field trials as explained above. This information is not currently publicly available from USDA's web site in chart form, and is found here in Appendix C. Appendix E also includes data from APHIS on the most frequently tested crops between 1987 and 2000, as well as a list of infrequently tested crops. The three data sets have minor discrepancies, and because of the different methods of presentation are not directly comparable.

Data sets are incomplete

USDA amended their permit regulations in the Federal Register on June 16, 1987, yet the agency lists June 16 as the first date of receipt of a permit request. It is unclear how an institution could have complied with new rules before they were publicly available. This first request, Calgene's permit #87-167-01, was a tomato resistant to the herbicide glyphosate. Although the USDA's on-line database lists the acreage of test as "not provided",[17] the Environmental Assessment in I.1.2(9) lists the size of the plot as "129' wide by 750' long," thus around 2.22 acres.[18]

This is symptomatic of the many problems that exist with data and its presentation on the USDA on-line database. For example, in every case USDA's Field Release Database lists the 1987 permits as having the acreage of test not provided, yet in every case it can be found within the text of the Environmental Assessment. The reality is that field tests in 1987 range in size from 0.017 to 10.44 acres (750 to 454,960 square feet). Currently, there is no information available about genetically engineered crops grown before the June 1987 USDA rule. All information about tests performed on genetically engineered crops is relevant to assessing the safety of this technology, and should be available to scientists and the public for review to the fullest extent possible. Another considerable problem with USDA's database is that the name of the introduced gene is left blank in several cases of approved crops, indicating (according to the table) that no data was provided by the institution submitting the request. If these are not errors in the database, this means that USDA is making safety assessments based on literally no data about the introduced gene. Finally, results from field tests are not available through the database, nor is information about which tests were performed under permit or notification procedures available in chart form.

"We risk disrupting the regulatory mechanisms that naturally keep pests in check."

RISKS ASSOCIATED WITH FIELD TESTING

Impacts on beneficial and other species

Potential impacts of genetically engineered crops on monarch butterfly larvae is fairly well known as a result of media attention.[19] Yet arguably more striking than the news from John Losey and colleagues that higher mortality for monarch larvae was encountered with *Bt* corn plants than their conventional counterparts was how, when the article was published, proponents of the technology had such superficial data with which to counter the findings. Monsanto had to admit that it had "not yet conducted its own research on *Bt*'s impact on monarch butterflies."[20] This admission came despite years of field test experiments. When a conference was hastily convened in November 1999 — organized and paid for in part by biotechnology companies[21] — its attempt to conclude that risk to the monarch was minimal was justifiably pilloried as a "manipulation."[22]

Despite the attention Losey's work has received in the media, unfortunately far fewer people have heard about other research demonstrating adverse effects on nontarget species from genetically engineered crops. Giroux et al. reported that the ladybug predator of the Colorado potato beetle consumed fewer potato beetle eggs when potato *Bt* levels were high.[23] And in work reported from the Swiss Federal Research Station for Agroecology and Agriculture, Hilbeck et al. have reported that lacewing larvae reared on prey that were fed *Bt*-producing corn took longer to develop and had a strikingly elevated mortality rate.[24] Other studies have produced similar results, including a four-year study in Wisconsin[25] and another in Ohio.[26] The National Research Council recently stated: "It is important to ask whether such indirect effects will have a harmful effect on the agroecosystem."[27] Unfortunately, the question is being asked and studied far too late. As Hilbeck has stated: "We risk disrupting the regulatory mechanisms that naturally keep pests in check."[28]

Genetic pollution

A critical component in monitoring field experiments of genetically engineered crops is to determine that genetically engineered organisms are contained and do not spread traits to nearby plants. However, USDA's belief when they designed their policy was that, "plants show no evidence of mechanisms to transfer genetic material directly from one organism to another."[29] USDA's scientifically inappropriate zeal to deregulate this technology about which so little is yet known is evidenced on this particular point by the recent discovery of an herbicide-tolerant canola plant that cross-pollinates with a related weed.[30] This could mean, among other results, that weeds will eventually emerge that are herbicide-resistant, and thus stronger, more toxic chemicals will be needed to get rid of them. USDA is also charged with determining the likelihood and range of pollen flow, but as a result of government complacency, in some cases it has been left up to activists around the world to gather information on this subject.[31] USDA has admitted that genetically engineered seeds may have moved outside of field test sites due to animal dispersal.[32] No published studies have examined the extent of the ecological consequences of this impact on natural populations.[33] Yet the potential for economic harm for farmers of genetic pollution are already real and severe.[34]

According to APHIS regulations, an application for a permit to conduct a field test of a genetically engineered crop must include "a detailed description of the proposed procedures…which will be used to prevent escape and dissemination of the regulated article at each of the intended destinations."[35] This is particularly important since many crops being field tested have not been approved for human consumption, and some never will, such as plants engineered to produce pharmaceutical proteins. But a review of environmental assessments offers many examples to demonstrate that, in fact, APHIS has not ensured that contamination is not taking place.[36] For example, APHIS concluded that cross-pollination of potato plants will not occur, yet "the nature or details of the documentation were not specified [and] no basis was given for the assurances of the applicant." Trials on genetically engineered squash and cantaloupe, which generally outcross and are insect pollinated, contained no requirement that flowers be removed from plants. And environmental assessments were accepted that cited data on adequate isolation distances that are contradicted by scientific literature. As a result, one environmental assessment suggested that 400 meters is an adequate isolation distance for field tests of squash, despite research confirming viable hybrid progeny of wild and cultivated squash separated by 1,300 meters. The authors state clearly: "APHIS does not require applicants to determine the extent and frequency of pollen movement nor the effectiveness of border rows in limiting the transmission of pollen during field tests."

Many farmers are relying more on crops that require strict segregation, many of which are not genetically engineered, to meet specific market demands that pay a premium price. Additionally, farmers are using a variety of farming methods — from pesticides to organic to Integrated Pest Management — that are specific to their crops. The drift onto or contamination of their land by genetically engineered material from undisclosed test plots could have serious financial implications. Stewart Wells of the National Farmers Union of Canada, for example, has stated that it may soon be impossible to certify canola as organic because no one will be able to guarantee that it does not contain genetically-engineered material. "If this continues, once wheat, barley, lentils and other crops are genetically-engineered, I won't have anything left to grow. For organic farmers and the hundreds of thousands of consumers who choose organic food, this is an extremely serious issue."[37] In the United Kingdom, the government recently announced that field experiments of genetically engineered corn would be halted for fear of genetic pollution of nearby organic farms.[38]

But the problem is far larger than for just organic growers. StarLink corn, for example, a variety approved only for animal feed and industrial use but not for human consumption, was nevertheless discovered in supermarket products.[39] The corn was never approved for human consumption because the corn produced a protein that exhibited two of the most common characteristics of known allergens. But not all farmers followed planting requirements,[40] and as a result all farmers are affected. The contamination of the corn supply with StarLink corn is largely to blame for the dramatic drop in U.S. corn exports: 6 percent overall, but as high as 30 percent for South Korea.[41] When government regulators learned that StarLink's manufacturer, Aventis, could not account for all of the 1999 seed sold that year, they simply believed the company when they assured the government "it was really an accounting problem."[42] Clearly the extent of contamination from field experiments (as well as commercial planting) is unknown, and farmers are not being adequately protected from genetic pollution. Abroad, harvested field tests of Monsanto's genetically engineered sugar beet – not approved for human consumption – were mixed with other crops destined for food processing.[43]

Pest resistance and "superweeds"

Plants engineered to kill insects are likely to hasten the creation of pesticide-resistant species, already a major problem.[44] *Bt* crops are engineered to produce the toxin Bacillus thuringiensis (*Bt*) in every cell in an attempt to make them resistant to certain types of pests. *Bt* is one of a limited number of tools that

Without regulatory oversight, genetically engineered plants will continue to hybridize with wild relatives, and potentially create serious problems as invasive species.

organic farmers have and can use as a natural pesticide. As a spray, *Bt* can be applied sparingly because of its reliable efficacy; it then breaks down very quickly. Genetically engineered *Bt* plants maintain a constant killing dose, however, raising the likelihood that insects will quickly develop resistance to *Bt*. Thus far the strategy has been to rely on high-dose *Bt* crops planted with a small "refuge" of non-genetically engineered crops nearby, but two recent developments indicate that the strategy is not foolproof.

First, although the strategy is predicated on high-dose crops, applications have been approved for Mycogen, Novartis, and DeKalb (now owned by Monsanto) for crops that produce only moderate doses.[45] A study published in 1999 raises concern that insects may develop resistance to moderate dose *Bt* corn, calling into question and potentially undercutting the high-dose-plus-refuge strategy.[46] Second, on January 14, 2000, new rules were announced for resistance management with *Bt* corn, because of fears of insects developing resistance to *Bt*.[47] According to the rules, no more than 80% of a field can be planted in *Bt* corn varieties, and in cotton-growing areas no more than 50% can be planted in *Bt* corn varieties. While this announcement is a further admission of inadequacies in the initial oversight of the technology, farmers that use *Bt* can now only wait and see if irreparable damage has not already been done.

Another significant ecological concern posed by the introduction of genetically engineered crops is that genes designed to give crops a competitive advantage may be passed to related wild plants with which they interbreed, spawning new "superweeds." In fact the current reliance on just a few broad-spectrum herbicides makes it likely that resistance will develop even faster. Already canola weeds resistant to three herbicides have been found in a field in northern Alberta, Canada.[48] And a recent scientific article reported that the physiological costs to the plant of this new trait are "negligible," suggesting that it may persist and spawn more troublesome weeds.[49] In fact the few studies of the relative fitness of hybrids between genetically engineered crops and wild relatives show that the hybrids are not necessarily less fit than their wild parent.[50] This problem is particularly troubling in light of the pell-mell rush into international commercialization of these crops. Without regulatory oversight, genetically engineered plants will continue to hybridize with wild relatives, and potentially create serious problems as invasive species. The costs imposed on the United States by non-native species is already estimated at $123 billion annually.

Other risks of genetically engineered crops

Damage to Soil Ecosystems

The results of applying this unpredictable new science to agriculture present other serious ecological risks. One profound but largely unexplored area is the damage genetically engineered crops may cause to soil ecosystems. Work published by Saxena et al. demonstrated that *Bt* toxin is released into the rhizosphere soil in root exudates from *Bt* corn.[51] They concluded that "there may be a risk that non-target insects and organisms in higher trophic levels could be affected by the toxin." In response to Saxena et al.'s research, the Biotechnology Industry Organization astoundingly claimed that, "It's hard to find anything here that's surprising."[52] If the news that a toxin retains its insecticidal properties for at least 234 days is not surprising, it is doubly troubling. Saxena's work is reinforced by Donegan and Seidler who state that "pesticidal proteins produced in transgenic plants can persist in soil and that binding of the proteins to soil particles can protect them from biotic degradation. We also found that plant genomic DNA in transgenic plants can persist in a field environment for several months."[53] In contrast to the laissez faire attitude of the Biotechnology Industry Organization, the authors point out that "it is crucial that risk assessment studies on the environmental use of transgenic plants consider the impacts on microbial communities. Research in this area has been quite limited, however, as demonstrated by the few available references."

Virus Resistance

Another ecological concern is the threat posed by plants engineered to be virus-resistant. Three main concerns are that new viral strains may arise, viral host ranges may be broadened, or that existing viral diseases may be more severe. Schoelz and Wintermantel[54] and Greene and Allison[55] have both reported instances of viral recombination. And concerns have been raised about the safety of one particular promoter – the cauliflower mosaic virus – used in nearly every genetically engineered plant either in commercialization or field trials.[56]

Increased Herbicide Use

One of the common claims made of genetic engineered crops by proponents of the technology is that it will allow for a reduction or elimination of the use of toxic farm chemicals (which have frequently been manufactured by the same companies now touting genetically engineered crops). It is estimated that pesticides harm society's interests to the extent of at least $100 billion per year,[57] and thus willingly allowing the use of such a dangerous technology to be furthered is profoundly unwise. A thorough benefit-cost analysis assessing the validity of this claim was never required to be carried out, and thus the mere suggestion that chemical use would be drastically cut was accepted as fact. The reality is that the technology may actually be used to perpetuate the pesticide era paradigm of agriculture rather than end it.[58] In fact, one of the first products field tested was a tobacco plant engineered to resist an herbicide classified by EPA as a possible carcinogen.[59] Among the most common genetically engineered crops on the market today are so-called Roundup Ready®, meaning they are resistant to an herbicide whose safety has been an ongoing matter of dispute.[60] In a survey of over 8,200 university-based soybean varietal trials in 1998, farmers used 2 to 5 times more herbicide with the Roundup Ready® soybeans as compared to other popular weed management systems.[61] This research was confirmed with new data published in 2001.[62]

Regulation of genetically engineered crops at USDA was predetermined to support the biotechnology industry.

ANALYSIS OF USDA OVERSIGHT

Regulation of genetic engineering at USDA

1984 Proposal

Regulation of genetically engineered crops at USDA was predetermined to support the biotechnology industry. The 1984 notice published by the Office of Science and Technology Policy (OSTP) made the goals of the Coordinated Framework clear: "[T]o enable a beneficial industry to proceed safely and efficiently…[it is] imperative that progress in biotechnology be encouraged."[63] The introduction emphasized that, "The U.S. also is committed to reducing barriers to trade in biotechnology."[64] In order for the USDA (and all government agencies involved in the oversight of genetically engineered organisms) to accommodate the encouragement of this industry as a matter of policy, and defend it in matters of international trade, it was decided that no new laws or agencies were needed. The existing statutes, the policy stated, "seem adequate," while the regulatory authorities in place "appear to accommodate these new products."[65] Given the complexity of the science and its potential impacts on human health, the environment, and the very structure of farming, one would have expected a great level of detail in oversight would be needed. Instead USDA's "Statement of U.S. Department of Agriculture Policy for Regulating Biotechnology Processes and Products" is a vague eight-page document.

The Proposal describes the mandate of the USDA, for which "the Department is chartered to develop new markets."[66] Shortly following this exhortation, the Department gives a two paragraph "Regulatory Philosophy," in which it states "USDA anticipates that agriculture and forestry products developed by modern biotechnology will not differ fundamentally from conventional products." Thus the department's philosophy of "substantial equivalence" makes it a simultaneous regulator and promoter of a powerful new technology. It would be fifteen years before any Secretary of Agriculture would even acknowledge this problem.[67]

The primary existing laws that USDA applies to the regulation of genetically engineered crops are the Federal Plant Pest Act (FPPA) of 23 May 1957[68] and the Plant Quarantine Act of 20 August 1912.[69] In an attempt at regulatory relief, the agency is trying to regulate a radically new technology under existing law like the FPPA which the agency admits was "gap filling legislation" itself.[70] The agency states these two Acts would be applicable to genetically engineered crops "if such plants…present a risk of plant pest introduction, spread, or establishment."[71] This raises two questions:

- What if they are not plant pests?
- What is a plant pest?

The answer to the second question, as defined by statute, means any living stage of any insects, mites, nematodes, slugs, snails, protozoa, or other invertebrate animals, bacteria, fungi, other parasitic plants or reproductive parts thereof, viruses, or any organisms similar to or allied with any of the foregoing, or any infectious substances, which can directly or indirectly injure or cause disease or damage in any plants or parts thereof, of any processed, manufactured, or other products of plants.[72]

Put more simply, a plant pest is anything that is a pest to a plant. Thus, USDA would examine a genetically engineered plant on whether or not it would damage any other plants and, if so, regulate it under existing statutes that require things like rapid quarantine and eradication. USDA is "mandated by statute to impose the least drastic action adequate" to monitor and prevent the spread of plant pests.[73] After applying this least restrictive approach to monitoring as a matter of regulation, the USDA, writing ten years before the first commercialization of a genetically engineered crop, had already decided that they would treat them "in the same manner as organisms developed by conventional methodologies."[74] The answer to the question of whether USDA would regulate these products if they were not determined to be plant pests is not explicitly given in the 1984 notice.

1986 Announcement of Policy

While USDA was deciding the scope of its regulation over the next 18 months, it did issue a policy statement that clearly demonstrates the desire for the strong protection of business interests concerning biotechnology.[75] But when the agency published both its final statement of policy under the Framework and also on the same day proposed new rules regarding oversight of field experiments of genetically engineered crops, the decisions were based on little empirical data and ignored many problems that genetically engineered crops may cause.[76] The resulting scenario reflects a situation in which business interests are given a higher priority than the interests of the public.

USDA proposed "not to regulate an organism or product merely because of the process by which it was produced," thus exempting certain products from regulation.[77] The Office of Science and Technology Policy's introduction to the Framework "anticipated" products would soon receive "exemption from any federal review."[78] Only 5 field tests in 1987 and 16 in 1988 went through USDA's permitting procedures; it is highly unlikely that there was a reduction from pre-1987 numbers, given that the numbers have increased nearly every year since. Yet still OSTP claimed that because "there is a substantial body of research indicating that such experiments are of low risk…not all experiments involving the environmental release of genetically engineered organisms require prior federal approval."[79] This claim, scientifically dubious given the dearth of data, opened a huge loophole in oversight.

Several other exemptions were included in the Framework, including the transfer of foreign genetic material not believed to have an impact.[80] OSTP also sought comment on exemptions of new organisms produced by exchanging genetic material within the same genera through genetic engineering as opposed to other methods.[81] In sum, OSTP declared that "at the present time existing statutes seem adequate to deal with the emerging processes and products of modern biotechnology."[82]

USDA significantly changed their policy statement for the Framework from 1984 to 1986, making it more clear that the agency "considers products developed through biotechnological techniques as no different from those products resulting from research using conventional techniques," assuming proper protocols.[83] The agency makes the unsupportable assumption that in "most cases it is expected that they [genetically engineered crops] will be improved, and would therefore not pose any new threat to humans, other animal species, or to the environment."[84] Based on agency determinations, "genetically engineered organisms that are not plant pests or where there is no reason to believe such organisms are plant pests would not be regulated."[85] There are also provisions for "certificates of exemption" for products of genetic engineering, exemptions for certain microorganisms,[86] and as mentioned above, the agency sought comments on exempting certain new organisms produced by intrageneric exchange.[87]

Knowing their regulations would "have a direct impact on the competitiveness of U.S. industry," USDA stressed the need to avoid having "inconsistent or unnecessary procedures."[88] USDA received 27 public

Many have questioned the commitment of USDA and others to a full exploration of the ethical dimension of genetic engineering.

comments on the whether the existing framework could be applied to products of genetic engineering, and 52% (14 people) disagreed with the judgment of the USDA. Undaunted, the agency responded that the "existing authority is considered adequate at this time."[89] Only seven respondents discussed the issue of risk assessment or risk/benefit analysis of genetic engineering, including one who gave a warning against attempting to regulate the "hypothetical and imaginary 'potential' dangers" of recombinant DNA techniques.[90] It is interesting that in responding to comments on risk analysis that, for the first and only time, the agency mentions the need to consider ethical issues in agricultural biotechnology research. Many have questioned the commitment of USDA and others to a full exploration of the ethical dimension of genetic engineering.[91]

1986 Proposal on Plant Pests

In addition to USDA's revised Statement of Policy for the Coordinated Framework for Regulation of Biotechnology, on the same day USDA's Animal and Plant Health Inspection Service (APHIS) issued a proposed rule focused on regulations for field tests of genetically engineered products. Under the rule, monitoring requirements were inadequate and almost nonexistent. Comprehensive ecological tests that would enable scientists to assess fundamental questions about the properties of genetically engineered organisms were not required, and possible routes of gene escape such as genetically engineered plants interbreeding with wild relatives were largely discounted. The agency again demonstrated a failure to use its authority to properly regulate this new technology.

In the proposed rule USDA laid out new requirements for permits for genetically engineered crops, including "that a written application for a permit should be submitted…at least 180 days in advance of the proposed introduction."[92] They later affirm their own guidelines by saying, "USDA believes that the 180 day time period required to process a permit application will not be an unreasonable delay in the marketing" of products produced through genetic engineering.[93] Monitoring reports were to be submitted only "as deemed necessary by the Deputy Administrator in order for Plant Protection and Quarantine, under certain circumstances…."[94] This was made easier for industry and researchers with considerations by USDA such as "[g]ene escape via a sexual transfer is not expected to occur and will not be considered."[95]

About 200 people responded to USDA in writing on their June 26, 1986 Federal Register notice, and the agency held one hearing in July and one in August on the proposed rule. Nearly all of the speakers at the hearings were representatives of industry, including Pioneer Hi-Bred, Agracetus, Calgene, and the Industrial Biotechnology Association. As an example of an industry's comments to the docket, Monsanto praised OSTP's failure to regulate products based on the production method, and the company urged expansions for certain exemptions.[96] In comments directed to EPA, Monsanto asked for a block of public information-sharing by recommending "that public meetings of the biotechnology Science Advisory Committee be held only if the nature of the research program and potential product can be maintained confidential...[I]t must be recognized that individual companies can be harmed by disclosure of the nature of their research as well as by disclosure of data."[97]

In comments directed at USDA, Monsanto asked for a removal of all regulation of genetically engineered crops. They declared that, "Logically, it would seem that the organisms produced by recombinant DNA methods should be exempted rather than those produced by classical techniques."[98] They criticized the agency for requiring too many experts to oversee the safety of research, claiming that committees "could soon result in an unwieldy size."[99] They also criticized the 180-day waiting period APHIS proposed before making a final decision on a regulated article, saying that it "is entirely too long in an age of rapid communication and electronic access to expertise worldwide. A maximum period of 45 days should be established."[100] They later state that:

With the exception of the 180-day period for APHIS review of plant pathogens, there is no clear definition of the time period required for review of proposals by the USDA. Such information is critical to timely research and development and seasonal field testing of agricultural biotechnology products. A time limit of 45 days should be incorporated into .407e, Review of Proposals.[101]

1987 Final Rule on Plant Pests

On June 16, 1987, USDA published the final version of its changes to 7 CFR, Chapter III.[102] The substance of the document was not changed from the 1986 proposal, leaving the agency with an inadequate system of monitoring in place. In the rule, USDA capitulated to industry pressure and changed the time necessary to submit an application for release of a genetically engineered organism into the environment from 180 days in advance to 120.[103] Many definitions, such as "classical genetics," "genetic manipulation," "mutagen," "pathogen," and "regulated article," were changed or dropped to be more favorable to industry's concerns. And in the final rule an example of the lack of scientific rigor upon which the agency's decisions were based is seen in the addition of a new, unscientific term for substantial equivalence that was introduced by APHIS: "so close."[104] As a result of concerns about the rule, the

General Accounting Office (GAO) was asked by the House Energy and Commerce Committee's Subcommittee on Oversight and Investigations to examine federal risk management policies and procedures applicable to field testing genetically engineered organisms. While USDA was proclaiming products of genetic engineering safe and barely regulating them, and industry was pushing them to do less, GAO's report sharply criticized weaknesses in USDA's regulations.

GAO report sharply criticizes USDA regulations

GAO faulted USDA for failing to adequately regulate genetic engineering, emphasizing that the agencies had based their regulations on insufficient data. As a result of the biotechnology framework, they pointed out, "Some organisms are not subject to regulation due to differences in legislative mandates and risk management policies. …[Thus] USDA [is] exempting certain categories of organisms from regulatory scrutiny prior to developing scientific information on the behavior of these organisms in the environment."[105] Commenting on a February 1, 1988 draft report, USDA wrote to GAO on March 18 that its exemptions were justified by their "limited nature."[106] GAO's response in June was clear: "the scientific basis for exempting from review certain genetically engineered organisms released into the environment has not yet been established."[107] GAO's methodology did not even examine the full range of flaws in USDA's oversight. They point out, for example, that, "As scientists have recognized, the problems that might be associated with large-scale introductions of genetically engineered organisms may differ from those of small-scale testing, which was the focus of our review."[108]

In response to a legal challenge to set aside the flawed framework, the U.S. District Court for the District of Columbia decided that "while the document is not a model of clarity…[its contents] are… merely a first effort to aid in the formulation of agency policy."[109] Now fifteen years later and in no way strengthened, USDA advertises the framework on their web site as "a well-coordinated system to ensure that new agricultural biotechnology products are safe."[110]

Ecologists have pointed out many shortcomings in assuming risks of releasing genetically engineered organisms into the environment based on experience in containment and/or small-scale field trials.[111] These include the difficulty in gathering data from such trials that speak to issues such as the potential for weediness, the potential for the spread of new viruses, and the potential impacts on nontarget species. But ecologists do not have the political muscle of the biotech industry, who are able to have the best of both worlds. For example, when attacking research at Cornell University's Department of Entomology on harm to monarch butterfly larvae from genetically engineered corn,[112] the biotech industry criticizes the work as a "laboratory test that failed to simulate natural conditions."[113] Yet ironically, when it comes to reducing the amount of necessary oversight for this radically new technology, the industry uses and argues for laboratory tests or small-scale field trials to adequately simulate real life conditions of full commercialization. Ecologists commenting on the framework concluded that "the regulatory issues for deliberate releases clearly are fundamentally different than for controlled laboratory situations and the probabilities of ecological side effects are much greater."[114]

In attempting to explain the adequacy of their regulations for genetically engineered organisms in response to criticism by GAO and others, USDA says that they narrowed the scope of their exemptions for certain microorganisms in their final rule. It should be noted that this exemption was not a trivial one, as evidenced by the characterization of one professor of microbiology (who testified on behalf of the American Society for Microbiology at congressional hearings) that it was "**scientifically indefensible**."[115] USDA's claims that their final rule conforms to the recommendation of critics to narrow the exemption were simply not true. As GAO explained, "We find no evidence of a narrowing of the exemption in USDA's final rule…[T]he scope of the exemption remained unchanged."[116]

These shortcomings on the part of USDA's policy were only part of the picture. A more fundamental failure, as mentioned above, was the narrow focus on the evaluation of the genetically engineered organisms' plant pest risk. In so doing, "USDA is not requesting sufficient information from the applicant to assess an organism's behavior in the environment and its potential ecological risk."[117] Or, as stated elsewhere, "no meaningful environmental data are being collected in the vast majority of the trials…The only questions being asked relate to the agronomic performance of the genetically modified plants, and the unwanted re-emergence of engineered plants in the following seasons, so-called volunteer plants."[118] The agency responded by pointing out that an examination of environmental effects is required under the National Environmental Policy Act. The already thin ice of this defense would be further eroded in a few years when USDA would propose excluding permitting and acknowledgment of notifications for confined field releases of genetically engineered organisms from the requirement to prepare environmental assessments or environmental impact statements.[119]

Despite being criticized as flawed and scientifically indefensible, the only significant changes to USDA's policy have been to weaken oversight.

Social and economic shortcomings of USDA policy

An additional and significant oversight in the policy, according to the National Agricultural Research and Extension Users Advisory Board in a report to the President and the Congress, was the failure to account for the overall impact on farmers and taxpayers. They noted:

> *"if relatively high-cost technology significantly increases production in a glutted market, the market price can fall sufficiently to erase any increase in profitability which the farmer may temporarily receive from adopting the technology. In a subsidized market, the American taxpayer pays a share of the bill for the new technology."*[120]

Their warning, largely unheeded by USDA, has turned out to be exactly true. Since the 1975-1979 period, consumer food prices have risen 250%, while prices farmers receive have remained nearly steady or in fact declined.[121] And while genetic engineering has not helped farmers, the amount of the burden that taxpayers have carried for this technology can not even be accurately measured. The Congressional Research Service reported that, "The Administration does not track federal food and agricultural biotechnology funding of research as a line item in federal budget analyses. Consequently, the total amount of public funding for this research is unclear."[122] Thus a technology that has not necessarily helped — and in fact in the long-term may be hurting many farmers — has been subsidized by American taxpayers in an unaccountable way. GAO's conclusion to their report rings truer than ever; USDA and other agencies:

> *"have generally not taken into account the possibility of secondary risks, especially in the area of social and economic impacts on agriculture and the use of agricultural chemicals."*

Recent changes in USDA regulatory oversight

Despite being criticized as flawed and scientifically indefensible, the only significant changes to USDA's policy have been to weaken oversight. In March 1993, after operating under a system of permits for less than six years, APHIS announced it was allowing certain crops to be grown without permitting.[123] Instead, institutions simply notified APHIS of their intention to conduct a field test because APHIS felt they had enough data to conclude these plants posed little or no ecological risk. The list was six plant species – corn, cotton, potato, soybean, tobacco, and tomato – as well as any "additional plant species that BBEP* has determined may be safely introduced."[124] The streamlined notification application was carefully worded to only ask, for example, if the plant would "[e]ncode substances that are known or likely to be toxic to nontarget organisms known or likely to feed or live on the plant species."[125] This wording ignores ecological impacts on species like monarch larvae that feed on nearby species like milkweed, and it fails to examine impacts on the soil, which are only recently being adequately explored.[126] In addition, even beyond Monsanto's hopes just a few years previous, APHIS would now have only 30 days to respond to a notification for environmental release.[127]

In a study produced in 1995, Joy Bergelson, an ecological geneticist at the University of Chicago, and Colin Purrington, now an evolutionary biologist at Swarthmore College, examined the seven genetically engineered crops approved by USDA for commercialization at that time. Their conclusion was that much of the data USDA was making its decisions on was from critically flawed experiments.[128] They also said the petitions relied in large part on unsupportable claims. Also in 1995, a report published in Bio/Technology surveyed all publicly available data from every field test.[129] In reviewing the 85 most recent reports of field trials, the authors note that none mentioned experiments to assess weediness, zero (of the 19) reports on virus-resistant crops mentioned experiments measuring the production of new virus strains, and none of the reports on *Bt* crops mentioned experiments on the likelihood of adverse impacts on nontarget insects.

Despite this, APHIS again proposed to "simplify procedures for the introduction of certain genetically engineered organisms."[130] It was estimated that 87 percent of all field trials were already being conducted under the simplified regulatory requirements.[131] APHIS felt that "petitions can and should be reviewed in a more streamlined manner,"[132] and set a goal that "about 99 percent" of tests would be conducted under a simplified notification procedure that required even less study than before.[133] To do so, a new set of crops would be deregulated. APHIS did not have a way to address them, and had to create a new term, "antecedent organism."[134] This was an organism that had already received non-regulated status, and would thus serve as a reference for comparison. This meant that as long as the new plant was "closely related," a vague term not defined but explained through one specific example, it was a candidate for non-regulated status.[135] USDA cited their experience at that time, having "approved, in whole or in part, eight petitions for a determination of nonregulated status."[136] This statement is inaccurate. According to USDA records, at the time sixteen crops were no longer regulated.[137] Regardless, scientists criticized the extension of deregulation as "beyond all reason."[138]

Strangely, on April 24, 1997, APHIS published a final rule[139] that they withdrew one week later saying it was "incorrect" and "contained errors."[140] When the new final rule was published on May 2, 1997, in the last major change to USDA's regulation of genetic engineering, more scientifically unsupportable decisions were made to further erode basic environmental safeguards.[141] Several steps were taken, including the erosion of field testing requirements, the simplification of procedures for further determinations of nonregulated status, and the reduced oversight over virus-resistant plants. In responding to criticism that the agency had not yet obtained any hard data that would allow them to assess specific environmental impacts, USDA admitted that "it is true that the majority of field trials of regulated articles have been conducted in the last two years."[142] Regardless, USDA still felt that with this paucity of data they could conclude that "there has been no reason to believe that any hypothetical 'long-term' impacts have arisen or are likely or foreseeable as a consequence of the conduct of any field trial in accordance with this final rule."[143] So with very little data to support such a decision, the agency shrugged off concerns with similar language a critic had used some years before (see note 90), and was able to call two years of testing 'long-term'.

With regard to virus resistant crops, USDA simultaneously concludes that more research is needed regarding the risks of virus resistant plants, yet states it is highly unlikely that there will be any new viruses as a result of field testing.[144] The desire for more research should be self-evident: their own report concluded that, "More research is needed…to assess the environmental and agricultural risks that might be presented by the commercialization of transgenic virus-resistant crops."[145] The results were something of a fait accompli, as USDA wrote about the time when "eventually, approval is sought to grow the regulated articles under routine agricultural conditions…(i.e., when a petition is submitted to APHIS for a determination of nonregulated status)."[146]

Among USDA's final responses to comments on their 1995 notice were the proposed simplifications on reporting requirements. Several people had commented that field requirements should be strengthened, but the agency felt that "no evidence in support of such a view was provided."[147] From the government's perspective to even "consider potential long term environmental effects…would be an exercise in speculation."[148] The evidence that field requirements should be strengthened is that clearly not enough evidence has been collected to make whole scale pronouncements of safety. The Biotechnology Industry Organization recently admitted that USDA may have erred in allowing certain crops to be deregulated prematurely,[149] and the 1997 rule is now the subject of a legal petition.[150] A comprehensive literature review published in December 2000 on the safety of genetically engineered crops concluded that key experiments are still lacking.[151] USDA's regulations are a classic example of a "don't look, don't find" mentality. Through the year 2000 there have been approximately 29,000 field tests of genetically engineered organisms under USDA's system. Yet because of the agency's inadequate oversight they have failed to undertake basic, fundamental explorations into the impact of genetically engineered organisms on human health, the environment, and a range of social and economic areas.

One final note regarding USDA's oversight of genetically engineered crops relates to the distinction between oversight in the so-called field testing stage versus oversight on genetically engineered crops grown commercially. While this paper focuses on field testing, it should be noted that part of the process for commercialization of a genetically engineered crop is to receive deregulated status from APHIS under the Plant Pest Act. Institutions petition for deregulation with information gathered from field tests. APHIS has never rejected a petition for deregulated status, and in every case when asked to do so has found that genetically engineered crops do not have a significant impact on the environment.[152]

The U.S. regulatory system must operate in a way that places public health and environmental protection as paramount considerations.

CONCLUSION & RECOMMENDATIONS

The lax regulation of genetically engineered organisms at USDA is predicated upon the scientifically dubious notion that genetically engineered plants are no different than traditionally bred plants. Moreover, the agency has supported and encouraged the development of this technology with minimal oversight, thus acting as an outspoken proponent of a technology that they are supposed to regulate dispassionately and objectively. Damage caused by genetic engineering to the environment may already be severe, including disruption of soil communities, damage to nontarget organisms, genetic pollution and biodiversity loss, and the perpetuation of heavy pesticide use by — in part — destroying the efficacy of *Bt* for use in farming and creating crops dependent on the application of synthetic chemicals. The impact of the technology on farmers and society in general has not been fully explored, nor has there been a full debate about the ethical dimension of genetic engineering. Other agencies, too, share part of the blame, and there needs to be a comprehensive restructuring of the regulations for genetically engineered foods and crops at all the major agencies involved in oversight. But as explained in this paper, USDA has rubber stamped nearly every application for genetically engineered field tests without a full understanding of the risks involved nor a full exploration of alternatives.

Consumer awareness and concern about the issue of genetic engineering has been higher abroad than in the United States thus far. However, as a result of incidents like the StarLink debacle and increased attention from public interest groups and the media, attention and concern are on the rise among American consumers. As people learn more about the risks of genetically engineered foods, they look to the USDA and other agencies for sufficient regulation and oversight to ensure a safe food supply with environmental protections. Thus far, by essentially automatically approving permits, USDA has not been playing an adequate regulatory role. The U.S. regulatory system must operate in a way that places public health and environmental protection as paramount considerations.

Genetically engineered products have not been properly tested for human health or environmental impact, nor have their social and ethical dimensions been adequately explored. Agencies should incorporate the suggestions listed below to ensure the protection of the environment, human health, and consumers' right to know. In addition, field tests of genetically engineered crops should only be conducted if a thorough and comprehensive ecological framework is established to assess their full impact. The tests conducted thus far have largely failed to answer basic, fundamental questions, and experimentation under the same lax regulations will continue to be of little value.

Accordingly, U.S. PIRG recommends a moratorium on the field testing and commercialization of genetically engineered foods and crops unless:

1) *Independent safety testing demonstrates they have no harmful effects on human health or the environment;*

Genetic engineering is a new science and carries with it new risks. USDA must immediately abandon the notion of substantial equivalence. This means that environmental assessments should be evaluated with the fundamental understanding that each new crop/gene combination is different and may present different risks. No crops should be approved until long-term, independently reviewed studies demonstrate and assess the range of ecological risks. This includes protocols for evaluating the risk of creating new plant viruses, the nontarget effects of plant-pesticides, as well as weediness potential and gene flow. The recent report from the National Research Council offers several recommendations that should be adopted without delay.[153]

2) *The public's right to know about field tests is improved and any products commercialized are labeled; and*

USDA should make all information about field tests available to the public via the world wide web in an easily navigable way. Currently, no information about tests conducted before June 1987 is available, and data about tests conducted since is parsimonious and organized in a way that is difficult to maneuver. Data should include the locations and size of all field tests, and all results should be made public. Any products commercialized after rigorous safety testing should be clearly labeled.

3) The biotechnology corporations that manufacture genetically engineered foods and crops are held responsible for any harm.

The possible effects on centers of biodiversity within the United States should be clearly evaluated. Contamination of farms that are not planted with genetically engineered crops, or genetic pollution of related species, must not be tolerated. USDA's failure to adequately address this issue with their December 2000 Organic Rule is disappointing. There should be the strongest possible liability for adverse impacts caused by genetically engineered products. Impacts of genetically engineered crops on the soil, nontarget organisms, other plants, the environment in general, and human health must be fully, rigorously, and continually reevaluated. Only about 1% of USDA's current budget looks at the environmental impact of genetic engineering.

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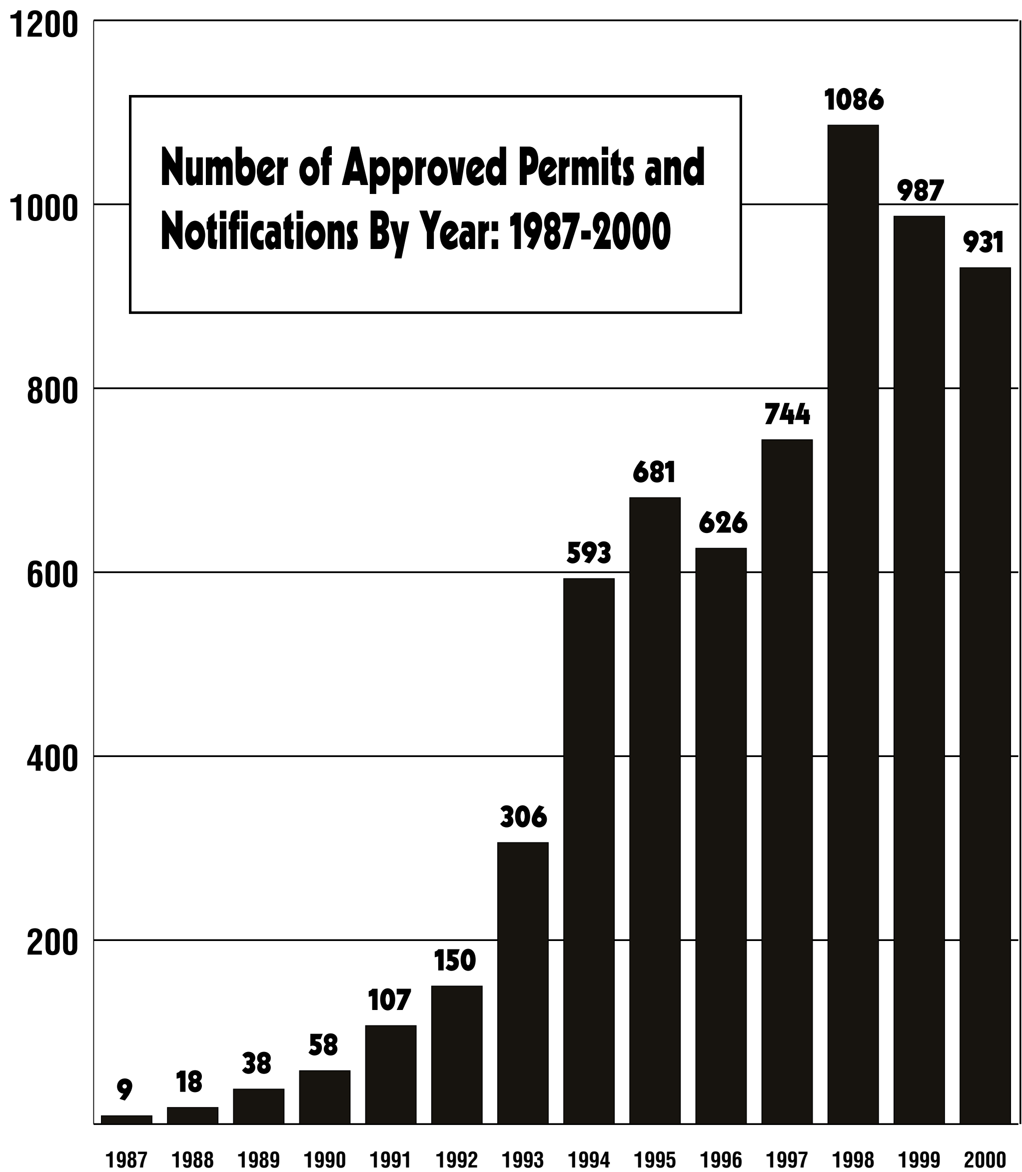
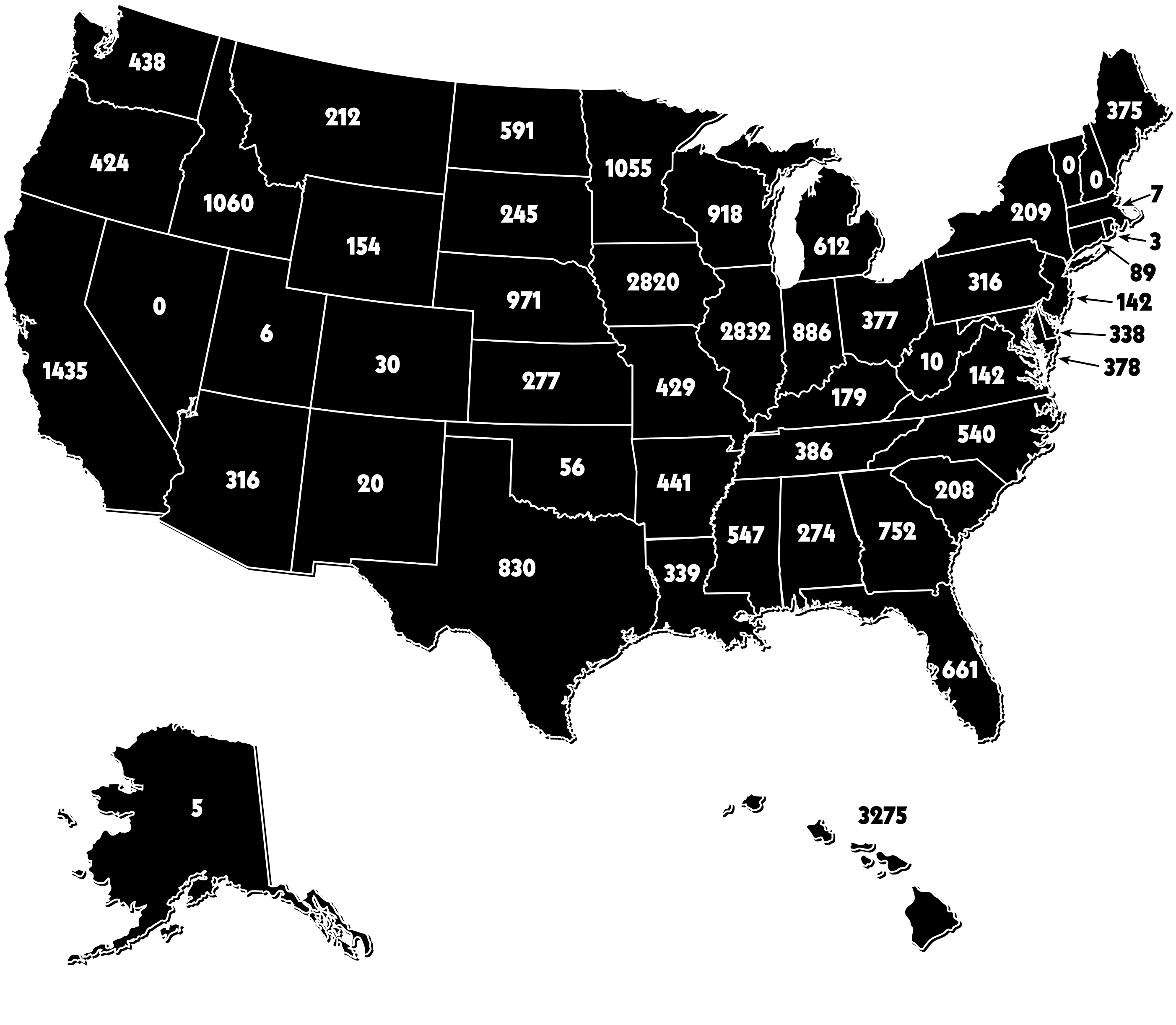
APPENDIX A:

Data from USDA Field Release Database Online



Number of Field Test Sites, Mapped



Number of Field Test Sites, Ranked

Rank	State	Number of Field Test Sites
1	HI	3275
2	IL	2832
3	IA	2820
4	PR	2296
5	CA	1435
6	ID	1060
7	MN	1055
8	NE	971
9	WI	918
10	IN	886
11	TX	830
12	GA	752
13	FL	661
14	MI	612
15	ND	591
16	MS	547
17	NC	540
18	AR	441
19	WA	438
20	MO	429
21	OR	424
22	TN	386
23	MD	378
24	OH	377

Rank	State	Number of Field Test Sites
25	ME	375
26	LA	339
27	DE	338
28	AZ	316
29	PA	316
30	KS	277
31	AL	274
32	SD	245
33	MT	212
34	NY	209
35	SC	208
36	KY	179
37	CO	154
38	NJ	142
39	VA	142
40	CT	89
41	OK	56
42	WY	30
43	NM	20
44	WV	10
45	MA	7
46	UT	6
47	AK	5
48	RI	3

Nevada, Vermont and New Hampshire had no field test sites.

Total Permit Applications and Results

Year	Received	Approved	Approved in Subsequent Year	Denied	Withdrawn	Void	Pending
1987	9	5	4	0	0	0	0
1988	18	12	6	0	0	0	0
1989	38	24	14	0	0	0	0
1990	58	37	21	0	0	0	0
1991	107	69	38	0	0	0	0
1992	161	122	28	0	11	0	0
1993	374	277	29	0	68	0	0
1994	608	555	38	6	9	0	0
1995	706	666	14	2	18	5	0
1996	654	590	35	8	20	0	0
1997	808	730	13	33	28	3	0
1998	1206	1061	25	108	10	2	0
1999	1061	961	26	46	22	6	0
2000	1012	899	32	57	15	1	8
Total	6820	6008	323	260	201	17	8

APPENDIX B:

Special Data Request by Information Systems for Biotechnology

Permits by Institution and Year

Institution	1987
Calgene	4
Du Pont	2
Monsanto	2
Crop Genetics	1

Institution	1988
Monsanto	5
Calgene	3
Du Pont	2
Agrigenetics	2
Sandoz	2
Crop Genetics	1
Agracetus	1
Iowa State U	1
Rohm and Haas	1

Institution	1989
Monsanto	14
Calgene	5
Upjohn	4
Northrup King	3
Iowa State U	2
Crop Genetics	1
Rohm and Haas	1
U of Kentucky	1
ARS	1
Auburn U	1
BioTechnica	1
Ciba-Geigy	1
New York State Exp Stn	1
Pioneer	1
U of California/Davis	1
U of Kentucky	1

Institution	1990
Monsanto	14
Calgene	9
Upjohn	7
ARS	6
Crop Genetics	2
U of Kentucky	2
DeKalb	2
BioTechnica	1
Ciba-Geigy	1
New York State Exp Stn	1
Pioneer	1
U of California/Davis	1
Du Pont	1
Amoco	1
U of Wisconsin	1
U of Wisconsin/Madison	1
Washington State U	1
Canners Seed	1
DNA Plant Tech	1
Frito Lay	1
Louisiana State U	1
North Carolina State U	1
Pennsylvania State U	1
Washington State U	1

Permits by Institution and Year

Institution	1991
Monsanto	20
Calgene	17
Pioneer	10
Frito Lay	9
Upjohn	5
ARS	4
DNA Plant Tech	4
Ciba-Geigy	3
Du Pont	3
U of California/Davis	2
Auburn U	2
Campbell	2
Holdens	2
Crop Genetics	1
U of Kentucky	1
DeKalb	1
BioTechnica	1
New York State Exp Stn	1
Amoco	1
Louisiana State U	1
North Carolina State U	1
U of Wisconsin	1
Northrup King	1
Rohm and Haas	1
Agrigenetics	1
U of Florida	1
U of Hawaii/Manoa	1
U of Idaho	1
Applied Starch Tech	1
Biosource	1
Cargill	1
Dow	1
Garst	1
Harris Moran	1
Montana State U	1
PetoSeed	1
Rogers NK	1

Institution	1992
Monsanto	41
Pioneer	19
Upjohn	13
Calgene	12
ARS	11
DeKalb	7
Frito Lay	5
Northrup King	5
Holdens	4
Ciba-Geigy	3
PetoSeed	3
DNA Plant Tech	2
Campbell	2
North Carolina State U	2
Cargill	2
Rogers NK	2
Washington State U	2
Hoechst-Roussel	2
ICI	2
InterMountain Canola	2
Auburn U	1
Crop Genetics	1
New York State Exp Stn	1
Amoco	1
Louisiana State U	1
U of Idaho	1
Harris Moran	1
Montana State U	1
U of Wisconsin/Madison	1
AgriPro	1
Agritope	1
American Cyanamid	1
Connecticut Ag Exp Stn	1
Cornell U	1
Heinz	1
Michigan State U	1
Noble Foundation	1
Purdue U	1
Stine Seeds	1
U of Arizona	1

Permits by Institution and Year

Institution	1993
Monsanto	109
Pioneer	35
Upjohn	28
Du Pont	19
Calgene	15
DeKalb	10
North Carolina State U	10
ARS	9
Northrup King	9
Ciba-Geigy	9
DNA Plant Tech	8
Michigan State U	6
Dairyland Seeds	6
Frito Lay	5
Cargill	5
Hoechst-Roussel	5
New York State Exp Stn	5
Delta and Pine Land	5
Holdens	3
ICI	3
U of Idaho	3
AgriPro	3
Agritope	3
American Cyanamid	3
Heinz	3
U of Kentucky	3
Miles	3
PetoSeed	2
Campbell	2
Louisiana State U	2
Noble Foundation	2
U of California/Davis	2
U of Wisconsin	2
U of Florida	2
AgrEvo	2
Asgrow	2
FFR Cooperative	2
Interstate Payco Seed	2
Land O Lakes	2
North Dakota State U	2
PanAmerican Seed	2
R J Reynolds	2
U of California/Berkeley	2
Rogers NK	1
InterMountain Canola	1
Amoco	1
Harris Moran	1
U of Wisconsin/Madison	1
Purdue U	1
U of Hawaii/Manoa	1
Dow	1
Agracetus	1
Amer Crystal Sugar	1
Betaseed	1
Virginia Tech	1
Washington U	1
Jacob Hartz	1
Midwest Oilseeds	1
Mississippi State U	1
Mycogen	1
Virginia Tech	1

Permits by Institution and Year

Institution	1994
Monsanto	141
Du Pont	93
Pioneer	63
Upjohn	28
DeKalb	28
Calgene	22
Frito Lay	15
Northrup King	13
DNA Plant Tech	13
PetoSeed	13
AgrEvo	12
Delta and Pine Land	11
Asgrow	11
North Carolina State U	7
Agracetus	7
ARS	6
Hunt-Wesson	6
Ciba-Geigy	5
Michigan State U	5
New York State Exp Stn	5
Holdens	5
U of Wisconsin	5
Zeneca	5
U of California	5
Zeneca	5
ICI	4
Agritope	4
U of Kentucky	4
U of Florida	4
Purdue U	4
Dairyland Seeds	3
U of Idaho	3
R J Reynolds	3
Betaseed	3
Mycogen	3
Rogers	3
Cargill	2
American Cyanamid	2
Harris Moran	2
Jacob Hartz	2
Cornell U	2
U of Chicago	2
All-Tex Seed	2
Rutgers U	2
U of Chicago	2
AgriPro	1
Heinz	1
Campbell	1
Noble Foundation	1
U of California/Davis	1
FFR Cooperative	1
Interstate Payco Seed	1
North Dakota State U	1
Rogers NK	1
InterMountain Canola	1
U of Wisconsin/Madison	1
Dow	1
Amer Crystal Sugar	1
Washington State U	1
Connecticut Ag Exp Stn	1
U of Georgia	1
Barham Seeds	1
U of Washington	1
Union Camp	1
United Agri Products	1
Van den Bergh Foods	1
VanderHave	1
Williams Seed	1
Brownfield Seed	1
Chembred	1
Dunn	1
Great Lakes Hybrids	1
Limagrain	1
Ohio State U	1
Seedco	1
U of Georgia	1
U of Washington	1
Union Camp	1

Permits by Institution and Year

Institution	1995
Monsanto	143
Du Pont	98
Pioneer	65
Northrup King	47
DeKalb	29
AgrEvo	29
Asgrow	24
Agracetus	20
Calgene	19
ARS	17
Delta and Pine Land	15
Holdens	14
DNA Plant Tech	13
PetoSeed	11
Ciba-Geigy	11
Cargill	10
Frito Lay	8
Purdue U	6
North Carolina State U	6
Betaseed	6
Michigan State U	5
U of Florida	5
U of Idaho	5
Great Lakes Hybrids	5
Hunt-Wesson	5
Cornell U	4
Rutgers U	4
New York State Exp Stn	4
Zeneca	3
Rogers	3
NC+ Hybrids	3
Agritope	3
ICI	3
U of Kentucky	3
Mycogen	3
Campbell	3
U of California	3
Golden Harvest Seeds	2
Southern Illinois U	2
Harris Moran	2
Louisiana State U	2
PanAmerican Seed	2
Oregon State U	2
U of Wisconsin	2
American Cyanamid	2
Iowa State U	2
Genetic Enterprises	2
New York State U/Albany	2
Jacob Hartz	2
InterMountain Canola	2
Dow	2
U of Chicago	1
Washington State U	1
U of Wisconsin/Madison	1
VanderHave	1
U of Minnesota	1
U of Minnesota	1
U of California/Davis	1
Amer Crystal Sugar	1
New Mexico State U	1
Plant Science Research	1
Dairyland Seeds	1
R J Reynolds	1
Heinz	1
Interstate Payco Seed	1
North Dakota State U	1
United Agri Products	1
Ohio State U	1
United Agri Products	1
Auburn U	1
U of Hawaii	1
Bejo	1
Dry Creek	1
Gargiulo	1
Nestle	1
Texas A&M	1

Permits by Institution and Year

Institution	1996
Monsanto	102
Pioneer	85
DeKalb	45
Asgrow	29
Agracetus	25
PetoSeed	21
AgrEvo	19
Du Pont	18
ARS	17
Calgene	15
Zeneca	13
Ciba-Geigy	12
U of Chicago	12
Frito Lay	11
Limagrain	11
Northrup King	10
Cargill	10
Michigan State U	10
Holdens	8
Purdue U	7
Rogers	7
Delta and Pine Land	6
DNA Plant Tech	6
NC+ Hybrids	6
WyFFels Hybrids	6
Seminis Vegetable Seeds	6
North Carolina State U	5
Betaseed	5
U of Florida	5
Cornell U	5
Golden Harvest Seeds	5
Washington State U	5
U of Idaho	4
Great Lakes Hybrids	4
Agritope	4
Southern Illinois U	4
U of Georgia	4
Sandoz	4
Becks Superior Hybrids	4
Rutgers U	3
ICI	3
U of Kentucky	3
Mycogen	3
Harris Moran	3
Louisiana State U	3
Boyce Thompson Institute	3
Plant Genetics	3
Campbell	2
PanAmerican Seed	2
Oregon State U	2
U of Wisconsin/Madison	2
VanderHave	2
U of Minnesota	2
Noble Foundation	2
Biosource	2
U of Illinois	2
BHN Research	2
Crows	2
Hilleshog	2
ICI Garst	2
Plant Genetic Systems	2
Sanford Scientific	2
Sunseeds	2
Texas Tech U	2
U of Illinois	2
U of California	1
U of Wisconsin	1
American Cyanamid	1
Iowa State U	1
Genetic Enterprises	1
New York State U/Albany	1
U of California/Davis	1
Amer Crystal Sugar	1
New Mexico State U	1
Plant Science Research	1
FFR Cooperative	1
Connecticut Ag Exp Stn	1
Union Camp	1
U of Arizona	1
U of North Carolina	1
American Takii	1
Applied Phytologics	1
Boswell	1
Tuskegee U	1
U of North Carolina	1
Coors Brewing	1
Tilak Raj Sawheny	1

Permits by Institution and Year

Institution	1997
Monsanto	208
Pioneer	122
Plant Genetic Systems	44
Du Pont	36
AgrEvo	33
DeKalb	27
Calgene	24
Seminis Vegetable Seeds	22
Novartis Seeds	19
ARS	16
Cargill	13
Agritope	11
Asgrow	10
Harris Moran	10
Limagrain	9
DNA Plant Tech	9
Mycogen	9
Oregon State U	8
U of Idaho	7
U of California/Davis	7
Stanford U	7
Agracetus	6
U of Kentucky	6
Betaseed	5
Frito Lay	4
Purdue U	4
Delta and Pine Land	4
NC+ Hybrids	4
WyFFels Hybrids	4
Southern Illinois U	4
U of Georgia	4
Rutgers U	4
U of Wisconsin/Madison	4
Biosource	4
Iowa State U	4
GenApps	4
Rhone-Poulenc	4
Zeneca	3
Zeneca	3
U of Chicago	3
Michigan State U	3
North Carolina State U	3
U of Florida	3
Great Lakes Hybrids	3
U of Minnesota	3
BHN Research	3
Auburn U	3
Texas A&M	3
Garst	3
ProdiGene	3
Stine Biotechnology	3
Holdens	2
Cornell U	2
Washington State U	2
Campbell	2
ICI Garst	2
Sunseeds	2
American Takii	2
Applied Phytologics	2
Tuskegee U	2
U of Hawaii	2
Dry Creek	2
U of Hawaii	2
U of California/Berkeley	2
Plant Sciences	2
Pure Seed Testing	2
Golden Harvest Seeds	1
Louisiana State U	1
VanderHave	1
Sanford Scientific	1
U of Wisconsin	1
American Cyanamid	1
Amer Crystal Sugar	1
New Mexico State U	1
U of Arizona	1
Weyerhaeuser	1
Yoder Brothers	1
North Carolina Dept of Agr	1
U of California/Kearney	1
Western Ag Research	1
Yoder Brothers	1
Boswell	1
Dow	1
North Dakota State U	1
Ohio State U	1
Gargiulo	1
U of Hawaii/Manoa	1
West Virginia U	1
Western Ag Research	1

Permits by Institution and Year

Institution	1998
Monsanto	293
AgrEvo	209
Pioneer	157
DeKalb	41
Du Pont	37
Novartis Seeds	31
Seminis Vegetable Seeds	26
Calgene	25
ARS	25
Iowa State U	21
U of Idaho	19
Cargill	16
Harris Moran	14
Rutgers U	13
Agritope	12
Mycogen	12
Stine Biotechnology	12
DNA Plant Tech	11
Oregon State U	10
Betaseed	10
Zeneca	10
Limagrain	9
Garst	9
GenApps	8
Rhone-Poulenc	8
U of Kentucky	7
Texas A&M	7
Scotts	7
Michigan State U	6
ProdiGene	6
Cornell U	6
Asgrow	5
Purdue U	5
U of Chicago	5
U of Minnesota	5
U of Wisconsin	5
U of Arizona	5
Texas Tech U	5
Stanford U	4
U of Florida	4
Tuskegee U	4
Golden Harvest Seeds	4
Louisiana State U	4
U of Illinois	4
NC+ Hybrids	3
U of Georgia	3
North Carolina State U	3
Washington State U	3
U of Hawaii	3
New Mexico State U	3
Union Camp	3
Coors Brewing	3
United States Sugar	2
Westvaco	2
Lipton	2
Michigan Tech U	2
United States Sugar	2
Westvaco	2
U of California/Davis	2
Southern Illinois U	2
Biosource	2
BHN Research	2
Auburn U	2
American Takii	2
Plant Genetics	2
AgraTech Seeds	2
Noble Foundation	1
U of California	1
Hunt-Wesson	1
New York State Exp Stn	1
Dairyland Seeds	1
Virginia Tech	1
Montana State U	1
U of Nebraska	1
W-L Research	1
Cook C Rutgers U	1
Illinois U	1
Pebble Ridge Vineyards	1
Thermo Trilogy	1
U of Nebraska	1
W-L Research	1
Great Lakes Hybrids	1
Sunseeds	1
Applied Phytologics	1
Sanford Scientific	1
American Cyanamid	1
Dow	1
Ohio State U	1
Western Ag Research	1
Boyce Thompson Institute	1

Permits by Institution and Year

Institution	1999
Monsanto	424
Pioneer	63
Seminis Vegetable Seeds	57
AgrEvo	40
ProdiGene	25
U of Idaho	22
Stine Biotechnology	22
Iowa State U	21
ARS	20
Rhone-Poulenc	19
U of Kentucky	16
Harris Moran	15
Rutgers U	15
Agritope	14
Mycogen	14
U of California/Davis	13
Zeneca	12
Stanford U	12
U of Florida	11
Cook C Rutgers U	11
Novartis Seeds	10
Oregon State U	10
Westvaco	10
Du Pont	9
DNA Plant Tech	9
Cornell U	9
U of Minnesota	7
Applied Phytologics	6
Dow	6
Calgene	5
Cargill	5
Scotts	5
Louisiana State U	5
Ohio State U	5
Boyce Thompson Institute	5
U of California	5
Montana State U	5
U of Hawaii/Manoa	5
AgriVitis	5
U of Chicago	4
Texas Tech U	4
U of Georgia	4
Southern Illinois U	4
United States Sugar	4
CropTech	4
Limagrain	3
Garst	3
Texas A&M	3
U of Hawaii	3
New Mexico State U	3
BHN Research	3
U of North Carolina	3
New York State U/Geneseo	3
DeKalb	2
Betaseed	2
Purdue U	2
Golden Harvest Seeds	2
Washington State U	2
American Takii	2
Noble Foundation	2
Dry Creek	2
North Dakota State U	2
New York State U/Albany	2
International Paper	2
U of Wisconsin	1
Tuskegee U	1
U of Illinois	1
North Carolina State U	1
Biosource	1
Lipton	1
U of Nebraska	1
W-L Research	1
Agracetus	1
U of California/Berkeley	1
Plant Sciences	1
Heinz	1
U of Washington	1
Pennsylvania State U	1
U of South Carolina	1
BioKyowa	1
Cal West Seeds	1
Colorado State U	1
U of California/San Diego	1

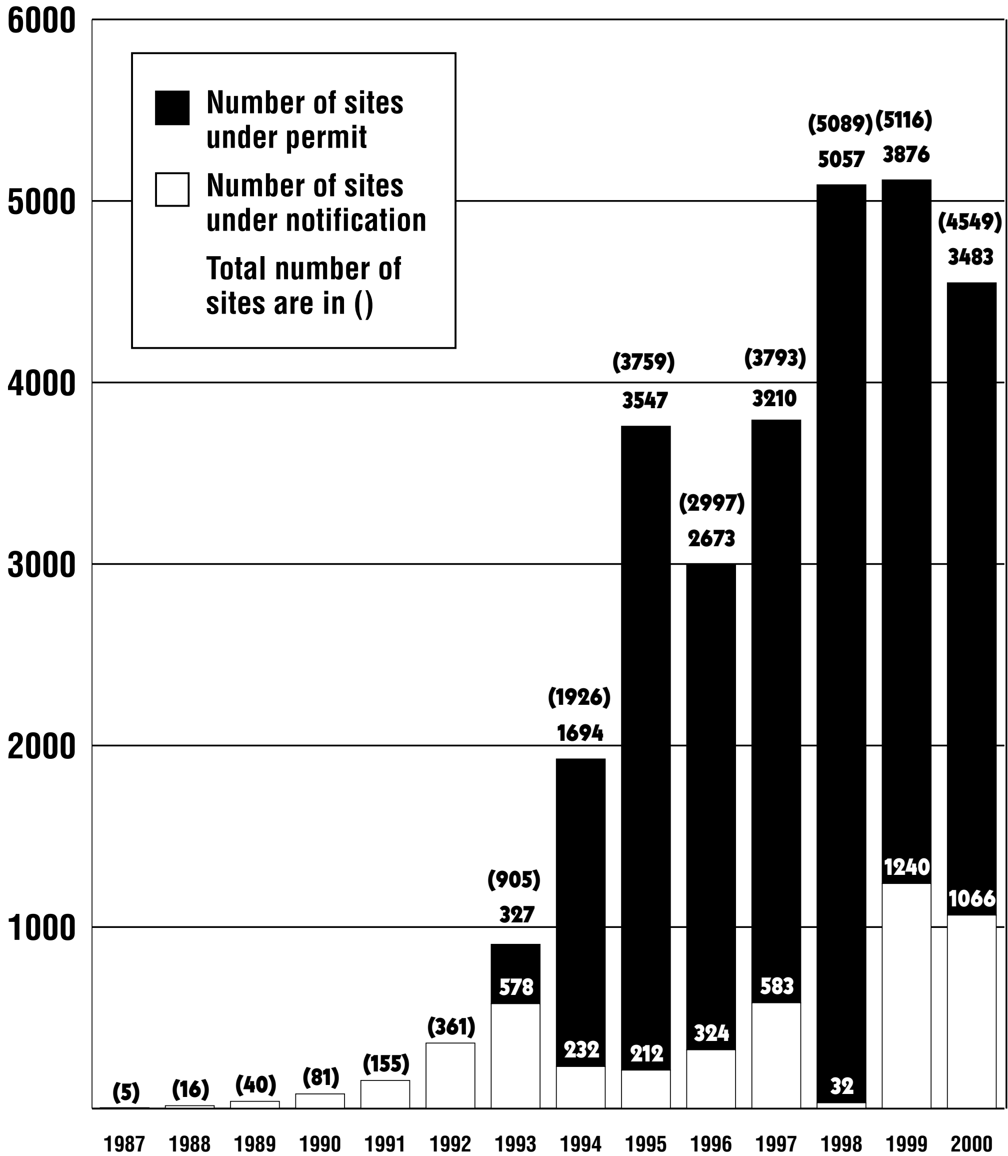
Permits by Institution and Year

Institution	2000
Monsanto	434
Aventis	55
Seminis Vegetable Seeds	41
ARS	32
Dow	26
ProdiGene	24
Rutgers U	24
Stanford U	23
Stine Biotechnology	22
Novartis Seeds	19
Scotts	17
Iowa State U	16
Pioneer	15
U of Idaho	13
Oregon State U	13
DNA Plant Tech	12
Zeneca	11
Westvaco	10
Betaseed	10
Agritope	8
U of Florida	8
CBI	8
Harris Moran	6
Applied Phytologics	6
BHN Research	6
Washington State U	6
U of North Carolina	5
ExSeed Genetics	5
U of Kentucky	4
Cargill	4
Texas Tech U	4
U of Georgia	4
Limagrain	4
GenApps	4
Cornell U	3
U of Minnesota	3
Montana State U	3
CropTech	3
New Mexico State U	3
Colorado State U	3
U of Arizona	3
Duke U	3
U of Connecticut	3
Du Pont	2
Louisiana State U	2
Ohio State U	2
New York State U/Geneseo	2
Noble Foundation	2
U of Wisconsin	2
Michigan Tech U	2
Virginia Tech	2
U of Nebraska/Lincoln	2
U of Rhode Island	2
Anton Caratan & Son	2
Integrated Plant Genetics	2
U of Nebraska/Lincoln	2
U of Rhode Island	2
Dry Creek	1
New York State U/Albany	1
International Paper	1
U of Illinois	1
North Carolina State U	1
Lipton	1
U of Nebraska	1
W-L Research	1
Plant Sciences	1
Cal West Seeds	1
Michigan State U	1
R J Reynolds	1
Mississippi State U	1
APHIS	1
Ball Helix	1
Wilson Genetics	1
Wright State U	1
Large Scale Biology	1
SemBioSys Genetics	1
Southern Piedmont AREC	1
Syngenta	1
Wilson Genetics	1
Wright State U	1
U of California	1
U of Chicago	1
Southern Illinois U	1

APPENDIX C:

Data from APHIS

Field Test Sites, 1987-2000



APPENDIX D:

State Acreage and Crop Data on Field Test Sites by State

ALABAMA	
Number of Field Releases	152
Number of Field Test Sites	274
Estimated Acreage	3070.9
Number of Permits without Acreage Information	44
Percent of Permits without Acreage Information	29%
Plants Tested 5 or More Times:	Number of Field Releases of each Crop
Cotton	66
Corn	30
Soy	26
Rapeseed	8
Tomato	5
Plants Tested Less than 5 Times:	
Potato	4
Sweet potato	4
Creeping Bentgrass	1

ALASKA	
Number of Field Releases	5
Number of Field Test Sites	5
Estimated Acreage	0.9
Number of Permits without Acreage Information	2
Percent of Permits without Acreage Information	40%
Plants Tested 5 or More Times:	Number of Field Releases of each Crop
NONE	
Plants Tested Less than 5 Times:	
Potato	4
Rice	1

State Acreage and Crop Data on Field Test Sites by State

ARIZONA

Number of Field Releases	162
Number of Field Test Sites	316
Estimated Acreage	25866.4
Number of Permits without Acreage Information	45
Percent of Permits without Acreage Information	28%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Cotton	68
Wheat	22
Rapeseed	19
Melon	14
Corn	12
Lettuce	10
Beet	7
Plants Tested Less than 5 Times:	
Tobacco	3
Creeping Bentgrass	2
Alfalfa	1
Melon, Squash	1
Rice	1
Tomato	1

ARKANSAS

Number of Field Releases	200
Number of Field Test Sites	441
Estimated Acreage	7004.2
Number of Permits without Acreage Information	55
Percent of Permits without Acreage Information	28%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Soy	90
Cotton	62
Rice	23
Corn	21
Plants Tested Less than 5 Times:	
Wheat	4

CALIFORNIA

Number of Field Releases	808
Number of Field Test Sites	1435
Estimated Acreage	17010.9
Number of Permits without Acreage Information	265
Percent of Permits without Acreage Information	33%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Tobacco	265
Corn	74
Melon	61
Rice	44
Lettuce	42
Potato	40
Rapeseed	41
Cotton	39
Strawberry	29
Beet	23
Cucumber	18
Brassica oleracea	13
Squash	13
Walnut	11
Melon, Squash	10
Sunflower	9
Apple	8
Pepper	8
Grape	7
Pea	7
Petunia	6
Wheat	6
Plants Tested Less than 5 Times:	
Persimmon	4
Carrot	3
Pelargonium	3
Rubus ideas	3
Barley	2
Soybean	2
Watermelon	2
Alfalfa	1
Crysanthemum	1
Creeping Bentgrass	1
Onion	1

State Acreage and Crop Data on Field Test Sites by State

COLORADO

Number of Field Releases	106
Number of Field Test Sites	154
Estimated Acreage	3880.0
Number of Permits without Acreage Information	17
Percent of Permits without Acreage Information	16%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	29
Potato	25
Beet	17
Rapeseed	17
Wheat	15
Plants Tested Less than 5 Times:	
Sunflower	2
Creeping Bentgrass	1

CONNECTICUT

Number of Field Releases	137
Number of Field Test Sites	89
Estimated Acreage	410.1
Number of Permits without Acreage Information	81
Percent of Permits without Acreage Information	59%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	129
Plants Tested Less than 5 Times:	
Soybean	3
Potato	1
Rhododendron	1

DELAWARE

Number of Field Releases	190
Number of Field Test Sites	338
Estimated Acreage	1881.5
Number of Permits without Acreage Information	47
Percent of Permits without Acreage Information	25%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	140
Soybean	41
Plants Tested Less than 5 Times:	
Potato	3
Tobacco	2
Tomato	2
Cotton	1
Squash	1

State Acreage and Crop Data on Field Test Sites by State

FLORIDA

Number of Field Releases	484
Number of Field Test Sites	661
Estimated Acreage	3877.6
Number of Permits without Acreage Information	105
Percent of Permits without Acreage Information	22%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	165
Tomato	125
Potato	87
Cotton	22
Soybean	20
Tobacco	10
Sugarcane	8
Rapeseed	7
Rice	5
Plants Tested Less than 5 Times:	
Carrot	4
Lettuce	4
Pepper	4
Petunia	4
Melon	2
Melon, Squash	2
Watermelon	2
Crysanthemum	1
Grapefruit	1
Papaya	1
Peanut	1
Squash	1
Strawberry	1

State Acreage and Crop Data on Field Test Sites by State

GEORGIA	
Number of Field Releases	213
Number of Field Test Sites	752
Estimated Acreage	6527.0
Number of Permits without Acreage Information	86
Percent of Permits without Acreage Information	40%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Cotton	46
Corn	46
Rapeseed	22
Soybean	21
Peanut	13
Melon, Squash	12
Tomato	11
Cucumber	9
Melon	9
Squash	6
Tobacco	6
Sweetgum	5
Plants Tested Less than 5 Times:	
Lettuce	3
Creeping Bentgrass	1
Potato	1
Watermelon	1

State Acreage and Crop Data on Field Test Sites by State

HAWAII

Number of Field Releases	1064
Number of Field Test Sites	3275
Estimated Acreage	8563.0
Number of Permits without Acreage Information	223
Percent of Permits without Acreage Information	21%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	989
Soybean	19
Rice	11
Wheat	11
Papaya	8
Cotton	6
Plants Tested Less than 5 Times:	
Sunflower	4
Tomato	4
Coffee	3
Lettuce	1
Peanut	1
Pineapple	1
Potato	1
Tobacco	1
Barley	1

IDAHO

Number of Field Releases	371
Number of Field Test Sites	1060
Estimated Acreage	20512.9
Number of Permits without Acreage Information	97
Percent of Permits without Acreage Information	26%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Potato	232
Corn	42
Beet	30
Wheat	25
Rapeseed	20
Barley	9
Alfalfa	7
Plants Tested Less than 5 Times:	
Pea	4
Tomato	1

ILLINOIS

Number of Field Releases	938
Number of Field Test Sites	2832
Estimated Acreage	8688.0
Number of Permits without Acreage Information	306
Percent of Permits without Acreage Information	33%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	712
Soybean	127
Tomato	23
Tobacco	14
Wheat	14
Arabidopsis thaliana	8
Rapeseed	7
Belladona	6
Potato	5
Plants Tested Less than 5 Times:	
Petunia	3
Barley	2
Carrot	2
Cotton	2
Alfalfa	1
Beet	1
Creeping Bentgrass	1
Melon, Squash	1
Pelargonium	1

State Acreage and Crop Data on Field Test Sites by State

INDIANA

Number of Field Releases	419
Number of Field Test Sites	886
Estimated Acreage	5553.5
Number of Permits without Acreage Information	99
Percent of Permits without Acreage Information	24%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	293
Soybean	79
Tomato	26
Wheat	6
Alfalfa	6
Plants Tested Less than 5 Times:	
Potato	3
Sunflower	1
Creeping Bentgrass	1

IOWA

Number of Field Releases	789
Number of Field Test Sites	2820
Estimated Acreage	10289.7
Number of Permits without Acreage Information	195
Percent of Permits without Acreage Information	25%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	643
Soybean	122
Alfalfa	12
Plants Tested Less than 5 Times:	
Beet	2
Poplar	2
Rapeseed	2
Tobacco	2
Oat	1

State Acreage and Crop Data on Field Test Sites by State

KANSAS

Number of Field Releases	112
Number of Field Test Sites	277
Estimated Acreage	915.6
Number of Permits without Acreage Information	40
Percent of Permits without Acreage Information	36%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	95
Soybean	9
Wheat	6
Plants Tested Less than 5 Times:	
Creeping Bentgrass	1
Tobacco	1

KENTUCKY

Number of Field Releases	105
Number of Field Test Sites	179
Estimated Acreage	571.4
Number of Permits without Acreage Information	37
Percent of Permits without Acreage Information	35%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Tobacco	50
Corn	26
Soybean	19
Plants Tested Less than 5 Times:	
Creeping Bentgrass	1
Poplar	1
Potato	1
Tomato	1

State Acreage and Crop Data on Field Test Sites by State

LOUISIANA

Number of Field Releases	129
Number of Field Test Sites	339
Estimated Acreage	1699.5
Number of Permits without Acreage Information	46
Percent of Permits without Acreage Information	36%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Cotton	46
Rice	41
Soybean	16
Corn	12
Sugarcane	7
Aspergillus flavus	5
Plants Tested Less than 5 Times:	
Strawberry	2
Sweet Potato	1

MAINE

Number of Field Releases	143
Number of Field Test Sites	375
Estimated Acreage	8185.3
Number of Permits without Acreage Information	30
Percent of Permits without Acreage Information	21%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Potato	142
Plants Tested Less than 5 Times:	
Corn	1

State Acreage and Crop Data on Field Test Sites by State

MARYLAND

Number of Field Releases	261
Number of Field Test Sites	378
Estimated Acreage	2259.6
Number of Permits without Acreage Information	70
Percent of Permits without Acreage Information	27%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	152
Soybean	77
Potato	9
Tomato	7
Plants Tested Less than 5 Times:	
Cotton	3
Squash	3
Creeping Bentgrass	1
Gladiolus	1
Tobacco	1

MASSACHUSETTS

Number of Field Releases	6
Number of Field Test Sites	7
Estimated Acreage	55.6
Number of Permits without Acreage Information	2
Percent of Permits without Acreage Information	33%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
NONE	
Plants Tested Less than 5 Times:	
Potato	4
Corn	1
Creeping Bentgrass	1

State Acreage and Crop Data on Field Test Sites by State

MISSISSIPPI

Number of Field Releases	245
Number of Field Test Sites	547
Estimated Acreage	28407.4
Number of Permits without Acreage Information	75
Percent of Permits without Acreage Information	31%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Cotton	142
Soybean	59
Corn	22
Rice	12
Plants Tested Less than 5 Times:	
Strawberry	2
Poplar	1
Tobacco	1

MICHIGAN

Number of Field Releases	239
Number of Field Test Sites	612
Estimated Acreage	5858.6
Number of Permits without Acreage Information	114
Percent of Permits without Acreage Information	48%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	90
Potato	55
Soybean	27
Beet	14
Melon	13
Rapeseed	11
Melon, Squash	8
Tomato	6
Cucumber	5
Plants Tested Less than 5 Times:	
Creeping Bentgrass	4
Watermelon	2
Poplar	2
Amelanchier laevis	1
Carrot	1

State Acreage and Crop Data on Field Test Sites by State

MINNESOTA	
Number of Field Releases	392
Number of Field Test Sites	1055
Estimated Acreage	11208.6
Number of Permits without Acreage Information	119
Percent of Permits without Acreage Information	30%
Plants Tested 5 or More Times:	Number of Field Releases of each Crop
Corn	255
Potato	48
Beet	27
Soybean	23
Rapeseed	16
Wheat	12
Alfalfa	6
Plants Tested Less than 5 Times:	
Poplar	2
Clavibacter xyli	1
Petunia	1
Sunflower	1

MISSOURI	
Number of Field Releases	215
Number of Field Test Sites	429
Estimated Acreage	4256.7
Number of Permits without Acreage Information	58
Percent of Permits without Acreage Information	27%
Plants Tested 5 or More Times:	Number of Field Releases of each Crop
Corn	129
Soybean	47
Cotton	20
Rice	9
Plants Tested Less than 5 Times:	
Potato	4
Tomato	3
Arabidopsis thaliana	1
Creeping Bentgrass	1

State Acreage and Crop Data on Field Test Sites by State

MONTANA	
Number of Field Releases	78
Number of Field Test Sites	212
Estimated Acreage	13602.1
Number of Permits without Acreage Information	16
Percent of Permits without Acreage Information	21%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Potato	32
Wheat	26
Beet	14
Rapeseed	5
Plants Tested Less than 5 Times:	
Corn	2

NEBRASKA	
Number of Field Releases	359
Number of Field Test Sites	971
Estimated Acreage	7271.7
Number of Permits without Acreage Information	94
Percent of Permits without Acreage Information	26%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	227
Soybean	30
Potato	25
Beet	14
Plants Tested Less than 5 Times:	
Wheat	3
Creeping Bentgrass	2
Sunflower	2
Melon, Squash	1
Rapeseed	1

NEVADA

Number of Field Releases	0
Number of Field Test Sites	0
Number of Permits without Acreage Information	0
Percent of Permits without Acreage Information	0%
Plants Tested 5 or More Times:	
NONE	
Plants Tested Less than 5 Times:	
NONE	

NEW HAMPSHIRE

Number of Field Releases	0
Number of Field Test Sites	0
Number of Permits without Acreage Information	0
Percent of Permits without Acreage Information	0%
Plants Tested 5 or More Times:	
NONE	
Plants Tested Less than 5 Times:	
NONE	

NEW JERSEY

Number of Field Releases	117
Number of Field Test Sites	142
Estimated Acreage	1795.3
Number of Permits without Acreage Information	51
Percent of Permits without Acreage Information	44%
Plants Tested 5 or More Times:	Number of Field Releases of each Crop
Creeping Bentgrass	58
Corn	10
Kentucky Bluegrass	13
Potato	8
Eggplant	7
Soybean	6
Bermudagrass	5
Plants Tested Less than 5 Times:	
Squash	2
Tobacco	2
Perennial ryegrass	2
Lettuce	1

State Acreage and Crop Data on Field Test Sites by State

NEW MEXICO	
Number of Field Releases	20
Number of Field Test Sites	20
Estimated Acreage	32.0
Number of Permits without Acreage Information	4
Percent of Permits without Acreage Information	20%
Plants Tested 5 or More Times:	Number of Field Releases of each Crop
Potato	14
Plants Tested Less than 5 Times:	
Corn	2
Soybean	2
Cotton	1
Onion	1

NEW YORK	
Number of Field Releases	151
Number of Field Test Sites	209
Estimated Acreage	1937.3
Number of Permits without Acreage Information	54
Percent of Permits without Acreage Information	36%
Plants Tested 5 or More Times:	Number of Field Releases of each Crop
Potato	44
Corn	30
Tomato	14
Grape	13
Melon	12
Apple	11
Squash	8
Plants Tested Less than 5 Times:	
Petunia	4
Brassica oleracea	3
Cucumber	3
Creeping Bentgrass	2
Cucurbita texana, Squash	2
Alfalfa	1
Melon, Squash	1
Papaya	1
Pelargonium	1
Poplar	1

NORTH CAROLINA

Number of Field Releases	253
Number of Field Test Sites	540
Estimated Acreage	1712.9
Number of Permits without Acreage Information	74
Percent of Permits without Acreage Information	29%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	95
Tobacco	55
Cotton	51
Soybean	19
Potato	8
Squash	5
Plants Tested Less than 5 Times:	
Arabidopsis thaliana	3
Brassica oleracea	3
Rapeseed	3
Tomato	3
Wheat	3
Poplar	1

NORTH DAKOTA

Number of Field Releases	192
Number of Field Test Sites	591
Estimated Acreage	20228.0
Number of Permits without Acreage Information	57
Percent of Permits without Acreage Information	30%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Potato	80
Beet	32
Rapeseed	26
Wheat	20
Corn	17
Sunflower	9
Soybean	5
Plants Tested Less than 5 Times:	
Barley	2
Cotton	1

State Acreage and Crop Data on Field Test Sites by State

OHIO	
Number of Field Releases	202
Number of Field Test Sites	377
Estimated Acreage	1386.4
Number of Permits without Acreage Information	66
Percent of Permits without Acreage Information	33%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	117
Soybean	31
Creeping Bentgrass	19
Kentucky Bluegrass	9
Potato	9
Tomato	8
Petunia	5
Plants Tested Less than 5 Times:	
Arabidopsis thaliana	1
Beet	1
Melon, Squash	1
Pelargonium	1

OKLAHOMA	
Number of Field Releases	35
Number of Field Test Sites	56
Estimated Acreage	191.6
Number of Permits without Acreage Information	12
Percent of Permits without Acreage Information	34%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	9
Cotton	9
Alfalfa	5
Plants Tested Less than 5 Times:	
Soybean	2
Tobacco	2
Wheat	2
Peanut	1
Potato	1
Russian Wildrye	1
Squash	1

State Acreage and Crop Data on Field Test Sites by State

OREGON

Number of Field Releases	221
Number of Field Test Sites	424
Estimated Acreage	9419.6
Number of Permits without Acreage Information	52
Percent of Permits without Acreage Information	24%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Potato	77
Beet	38
Poplar	25
Creeping Bentgrass	22
Melon	13
Tomato	9
Apple	7
Kentucky Bluegrass	7
Rubus idaeus	5
Strawberry	5
Wheat	5
Plants Tested Less than 5 Times:	
Corn	2
Pear	2
Rapeseed	2
Alfalfa	1
Melon, Squash	1

PENNSYLVANIA

Number of Field Releases	121
Number of Field Test Sites	316
Estimated Acreage	1124.1
Number of Permits without Acreage Information	39
Percent of Permits without Acreage Information	32%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	94
Soybean	13
Potato	8
Plants Tested Less than 5 Times:	
Alfalfa	3
Creeping Bentgrass	1
Kentucky Bluegrass	1
Squash	1

State Acreage and Crop Data on Field Test Sites by State

PUERTO RICO

Number of Field Releases	732
Number of Field Test Sites	2296
Estimated Acreage	9214.0
Number of Permits without Acreage Information	94
Percent of Permits without Acreage Information	13%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	499
Soybean	156
Cotton	60
Rice	10
Tomato	7
Plants Tested Less than 5 Times:	
NONE	

RHODE ISLAND

Number of Field Releases	3
Number of Field Test Sites	3
Estimated Acreage	69.0
Number of Permits without Acreage Information	0
Percent of Permits without Acreage Information	0%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
NONE	
Plants Tested Less than 5 Times:	
Potato	2
Creeping Bentgrass	1

SOUTH CAROLINA

Number of Field Releases	103
Number of Field Test Sites	208
Estimated Acreage	1429.5
Number of Permits without Acreage Information	28
Percent of Permits without Acreage Information	27%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Cotton	47
Soybean	12
Pine	8
Rapeseed	8
Sweetgum	5
Plants Tested Less than 5 Times:	
Tobacco	4
Poplar	3
Squash	3
Potato	2
Sweet potato	2
Alfalfa	1
Chrysanthemum	1
Corn	1
Tomato	1

SOUTH DAKOTA

Number of Field Releases	109
Number of Field Test Sites	245
Estimated Acreage	948.6
Number of Permits without Acreage Information	29
Percent of Permits without Acreage Information	27%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	82
Wheat	19
Soybean	13
Plants Tested Less than 5 Times:	
Rapeseed	2
Beet	1
Potato	1
Sunflower	1

State Acreage and Crop Data on Field Test Sites by State

TENNESSEE

Number of Field Releases	182
Number of Field Test Sites	386
Estimated Acreage	2758.0
Number of Permits without Acreage Information	63
Percent of Permits without Acreage Information	35%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	101
Cotton	37
Soybean	38
Plants Tested Less than 5 Times:	
Tobacco	4
Rice	1
Squash	1

TEXAS

Number of Field Releases	254
Number of Field Test Sites	830
Estimated Acreage	4256.6
Number of Permits without Acreage Information	66
Percent of Permits without Acreage Information	26%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Cotton	108
Corn	79
Rice	17
Soybean	14
Sugarcane	9
Plants Tested Less than 5 Times:	
Melon	4
Potato	4
Squash	4
Beet	3
Grapefruit	3
Rapeseed	3
Brassica oleracea	2
Melon, Squash	2
Carrot	1
Onion	1
Tobacco	1
Tomato	1

UTAH

Number of Field Releases	3
Number of Field Test Sites	6
Estimated Acreage	55.4
Number of Permits without Acreage Information	0
Percent of Permits without Acreage Information	0%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
NONE	
Plants Tested Less than 5 Times:	
Alfalfa	1
Beet	1
Kentucky Bluegrass	1

VERMONT

Number of Field Releases	0
Number of Field Test Sites	0
Number of Permits without Acreage Information	0
Percent of Permits without Acreage Information	0%
Plants Tested 5 or More Times:	
NONE	
Plants Tested Less than 5 Times:	
NONE	

VIRGIN ISLANDS

Number of Field Releases	0
Number of Field Test Sites	0
Number of Permits without Acreage Information	0
Percent of Permits without Acreage Information	0%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
NONE	
Plants Tested Less than 5 Times:	
NONE	

State Acreage and Crop Data on Field Test Sites by State

VIRGINIA	
Number of Field Releases	88
Number of Field Test Sites	142
Estimated Acreage	725.9
Number of Permits without Acreage Information	18
Percent of Permits without Acreage Information	20%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Corn	21
Tobacco	18
Potato	16
Soybean	14
Cotton	6
Plants Tested Less than 5 Times:	
Poplar	4
Tomato	4
Squash	3
Beet	1
Creeping Bentgrass	1

WASHINGTON

Number of Field Releases	198
Number of Field Test Sites	438
Estimated Acreage	11177.3
Number of Permits without Acreage Information	59
Percent of Permits without Acreage Information	30%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Potato	97
Wheat	20
Creeping Bentgrass	13
Grape	9
Barley	9
Alfalfa	8
Beet	7
Poplar	7
Apple	6
Rapeseed	6
Pea	5
Plants Tested Less than 5 Times:	
Corn	3
Rubus idaeus	3
Pear	2
Tobacco	1

WEST VIRGINIA

Number of Field Releases	10
Number of Field Test Sites	10
Estimated Acreage	5.1
Number of Permits without Acreage Information	2
Percent of Permits without Acreage Information	20%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
NONE	
Plants Tested Less than 5 Times:	
Plum	3
Apple	2
Pear	2
Potato	1

WISCONSIN

Number of Field Releases	441
Number of Field Test Sites	918
Estimated Acreage	13162.2
Number of Permits without Acreage Information	125
Percent of Permits without Acreage Information	28%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Potato	169
Corn	161
Soybean	42
Alfalfa	21
Cotton	8
Rapeseed	7
Tomato	6
Plants Tested Less than 5 Times:	
Beet	3
Tobacco	3
Creeping Bentgrass	2
Poplar	2
Cranberry	1
Onion	1
Poplar, Spruce	1

WYOMING

Number of Field Releases	16
Number of Field Test Sites	30
Estimated Acreage	42.8
Number of Permits without Acreage Information	5
Percent of Permits without Acreage Information	31%
Plants Tested 5 or More Times:	**Number of Field Releases of each Crop**
Beet	12
Plants Tested Less than 5 Times:	
Corn	2
Rapeseed	1

Totals For All States

Total Number of Field Releases	11773
Total Number of Field Test Sites	28906
Total Estimated Acreage	288614.6
Total # of Permits Without Acreage Information	3266
Total % Of Permits Without Acreage Information	28%

All Organisms:	Number Of Field Releases Of Each Organism
Alfalfa	84
Amelanchier laevis	1
Anthurium andreanum	1
Apple	34
Aspergillus flavus	13
Arabidopsis Thaliana	10
Barley	25
Beet	236
Belladonna	6
Bermudagrass	2
Brassica oleracea	21
Brassica rapa	0
Cephalosporium gramineum	2
Coffee	3
Carrot	11
Chrysanthemum	3
Cichorium intybus	1
Clavibacter	0
Clavibacter xyli	14
Corn	5658
Cotton	852
Cranberry	1
Creeping Bentgrass	134
Cryphonectria parasitica	4
Cucumber	35
Cucurbita texana, Squash	2
Dendrobium	3
Eggplant	7
Festuca arundinacea	3
Fusarium moniliforme	9
Gladiolus	1
Grape	29
Grapefruit	4
Heterorhabditis bacteriophora	1
Kentucky Bluegrass	28
lettuce	61
Melon	128

Totals For All States (continued)

All Organisms:	Number Of Field Releases Of Each Organism
Melon, Squash	40
Metaseiulus occidentalis	1
Oat	1
Onion	4
Papaya	10
Pea	16
Peanut	16
Pear	6
Pelargonium	6
Pepper	12
Perennial ryegrass	1
Persimmon	4
Petunia	23
Pine	8
Pineapple	1
Plum	3
Poplar	51
Poplar, Spruce	1
Populus deltoides	6
Potato	1265
Pseudomonas syringae	14
Rape Seed	233
Rhizobium	3
Rhododendron	1
Rice	175
Rubus idaeus	11
Russian wildrye	1
Soy	1225
Squash	53
Strawberry	39
Sugar Cane	24
Sunflower	29
Sweet Gum	10
Sweet Potato	8
TEV	1
TMV	9
Tobacco	446
Tomato	268
Walnut	11
Watermelon	7
Wheat	219
Xanthomonas	8
TOTAL	**11,697**

Field Releases by State and Crop

CROP	AK	AL	AR	AZ	CA	CO	CT	DE	FL	GA	HI	IA	ID	IL	IN	KS
Alfalfa				1	1							12	7	1	6	
Amelanchier laevis																
Anthurium andreanum											1					
Apple					8											
Arab. thaliana														8		
Aspergillus flavus																
Barley					2						1		9	2		
Beet				7	23	17						2	30	1		
Belladonna														6		
Bermudagrass																
Brassica oleracea					13											
Cephalosporium gramineum																
Coffee											3					
Carrot					3				4					2		
Chrysanthemum					1				1							
Cichorium intybus					1											
Clavibacter xyli												1		1		
Corn		30	21	12	74	29	129	140	165	46	989	643	42	712	293	95
Cotton		66	62	68	39			1	22	46	6			2		
Cranberry																
Creeping Bentgrass		1		2	1	1				1				1	1	1
Cryphonectria parasitica							2									
Cucumber					18					9						
Cucurbita texana, Squash																
Dendrobium											3					
Eggplant																
Festuca arundinacea															1	
Fusarium moniliforme												1		6	2	
Gladiolus																
Grape					7											
Grapefruit									1							
Heterorhabditis bacteriophora																
Kentucky Bluegrass																
Lettuce				10	42				4	3	1					
Melon				14	61				2	9						
Melon, Squash				1	10				2	12				1		
Metaseiulus occidentalis									1							
Oat												1				
Onion					1											
Papaya									1		8					

Field Releases by State and Crop

CROP	AK	AL	AR	AZ	CA	CO	CT	DE	FL	GA	HI	IA	ID	IL	IN	KS
Pea					7								4			
Peanut									1	13	1					
Pear																
Pelargonium					3									1		
Pepper					8				4							
Perennial ryegrass																
Persimmon					4											
Petunia					6				4					3		
Pine																
Pineapple											1					
Plum																
Poplar												2				
Poplar, Spruce																
Populus deltoides																
Potato	4	4			40	25	1	3	87	1	1		232	5	3	
Pseudomonas syringae		3			1											
Rape Seed		8		19	41	17			7	22		2	20	7		
Rhizobium etli, Rhizobium leguminosarum, Rhizobium																
Rhododendron							1									
Rice	1		23	1	44				5		11					
Rubus idaeus					3											
Russian wildrye																
Soy		26	90		2		3	41	20	21	19	122		127	79	9
Squash					13			1	1	6						
Strawberry					29				1							
Sugar Cane									8							
Sunflower						2					4					
Sunflower					9										1	
Sweet Gum										5						
Sweet Potato		4														
TEV																
TMV									1							
Tobacco				3	265			2	10	6	1	2		14		1
Tomato		5		1				2	125	11	4		1	23	26	
Walnut					11											
Watermelon					2				2	1						
Wheat			4	22	6	15					11		25	14	6	6
Xanthomonas		6							2							

Field Releases by State and Crop

CROP	KY	LA	MA	MD	ME	MI	MN	MO	MS	MT	NC	ND	NE	NJ	NM	NY
Alfalfa							6									1
Amelanchier laevis						1										
Anthurium andreanum																
Apple																11
Arab. thaliana								1			3					
Aspergillus flavus		5							5							
Barley												2				
Beet						14	27			14		32	14			
Belladonna																
Bermudagrass														5		
Brassica oleracea											3					3
Cephalosporium gramineum																
Coffee																
Carrot						1										
Chrysanthemum																
Cichorium intybus																
Clavibacter xyli				7			1						4			
Corn	26	12	1	152	1	90	255	129	22	2	95	17	227	10	2	30
Cotton		46		3				20	142		51	1			1	
Cranberry																
Creeping Bentgrass	1		1	1		4		1					2	58		2
Cryphonectria parasitica																
Cucumber						5										3
Cucurbita texana, Squash																2
Dendrobium																
Eggplant														7		
Festuca arundinacea																
Fusarium moniliforme																
Gladiolus				1												
Grape																13
Grapefruit																
Heterorhabditis bacteriophora														1		
Kentucky Bluegrass														13		
Lettuce														1		
Melon						13										12
Melon, Squash						8							1			1
Metaseiulus occidentalis																
Oat																
Onion															1	
Papaya																1

Field Releases by State and Crop

CROP	KY	LA	MA	MD	ME	MI	MN	MO	MS	MT	NC	ND	NE	NJ	NM	NY
Pea																
Peanut																
Pear																
Pelargonium																1
Pepper																
Perennial ryegrass														2		
Persimmon																
Petunia							1									4
Pine																
Pineapple																
Plum																
Poplar	1					2	2		1		1					1
Poplar, Spruce																
Populus deltoides								1								
Potato	1		4	9	142	55	48	4		32	8	80	25	8	14	44
Pseudomonas syringae																
Rape Seed						11	16			5	3	26	1			
Rhizobium etli, Rhizobium leguminosarum, Rhizobium																
Rhododendron																
Rice		41						9	12							
Rubus idaeus																
Russian wildrye																
Soy	19	16		77		27	23	47	59		19	5	30	6	2	
Squash				3							5			2		8
Strawberry		2							2							
Sugar Cane		7														
Sunflower							1					9	2			
Sunflower																
Sweet Gum																
Sweet Potato		1														
TEV	1															
TMV	5										3					
Tobacco	50			1					1		55			2		
Tomato	1			7		6		3			3					14
Walnut																
Watermelon						2										
Wheat							12			26	3	20	3			
Xanthomonas																

Field Releases by State and Crop

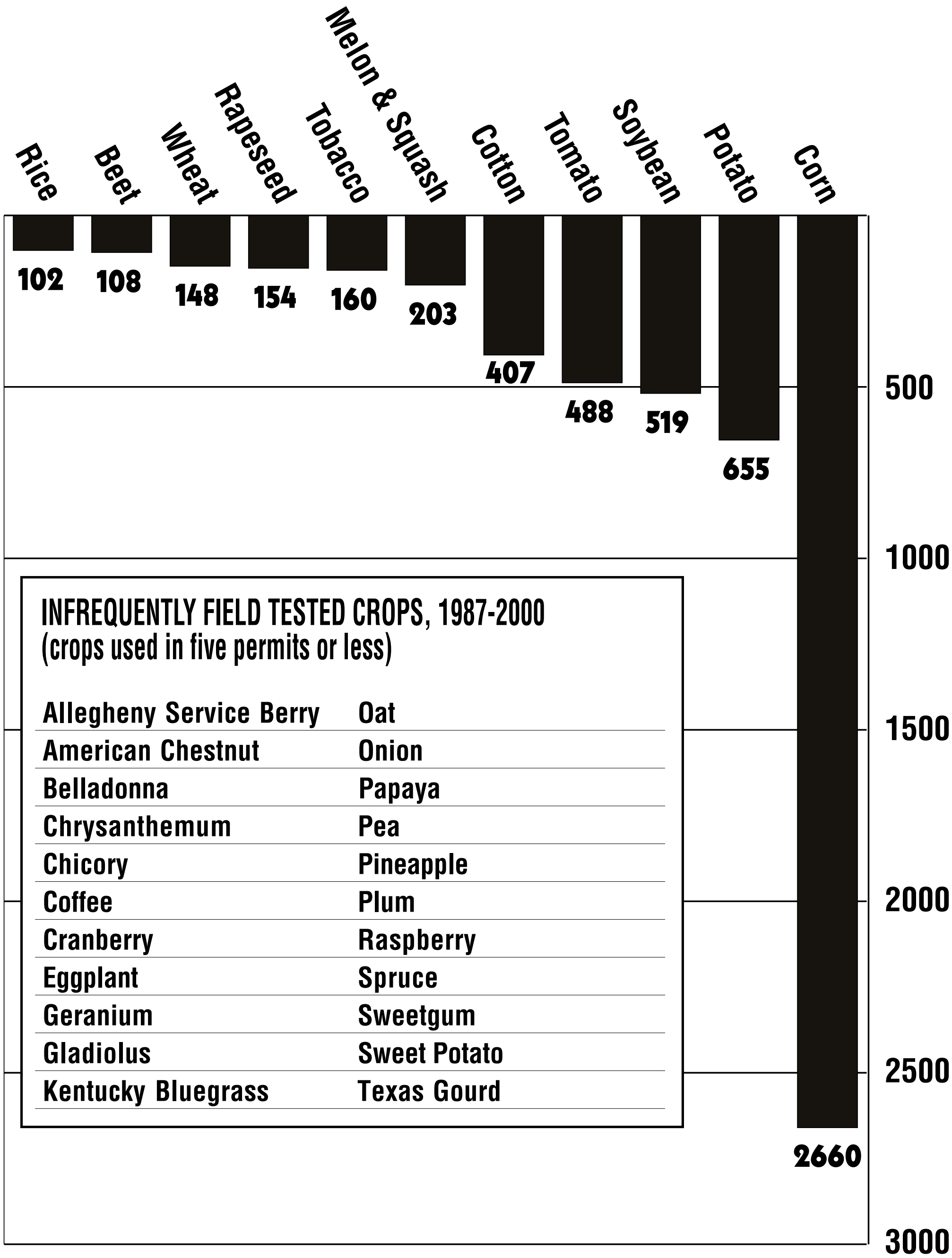
CROP	OH	OK	OR	PA	PR	RI	SC	SD	TN	TX	UT	VA	VI	WA	WI	WV	WY
Alfalfa		5	1	3			1				1			8	21		
Amelanchier laevis																	
Anthurium andreanum																	
Apple			7											6		2	
Arab. thaliana	1																
Aspergillus flavus																	
Barley														9			
Beet	1		38					1		3	1	1		7	3		12
Belladonna																	
Bermudagrass																	
Brassica oleracea										2							
Cephalosporium gramineum														2			
Coffee																	
Carrot										1							
Chrysanthemum							1										
Cichorium intybus																	
Clavibacter xyli																	
Corn	117	9	2	94	499		1	82	101	79		21		3	161		2
Cotton		9			60		47		37	108		6			8		
Cranberry															1		
Creeping Bentgrass	19		22	1		1						1		13	2		
Cryphonectria parasitica																2	
Cucumber																	
Cucurbita texana, Squash																	
Dendrobium																	
Eggplant																	
Festuca arundinacea		2															
Fusarium moniliforme																	
Gladiolus																	
Grape														9			
Grapefruit										3							
Heterorhabditis bacteriophora																	
Kentucky Bluegrass	9		7	1							1						
Lettuce																	
Melon			13							4							
Melon, Squash	1		1							2							
Metaseiulus occidentalis																	
Oat																	
Onion										1					1		
Papaya																	

Field Releases by State and Crop

CROP	OH	OK	OR	PA	PR	RI	SC	SD	TN	TX	UT	VA	VI	WA	WI	WV	WY
Pea														5			
Peanut		1															
Pear			2											2		2	
Pelargonium	1																
Pepper																	
Perennial ryegrass																	
Persimmon																	
Petunia	5																
Pine							8										
Pineapple																	
Plum																3	
Poplar			25				3					4		7	2		
Poplar, Spruce															1		
Populus deltoides							5										
Potato	9	1	77	8		2	2	1		4		16		97	169	1	
Pseudomonas syringae															10		
Rape Seed			2				8	2		3				6	7		1
Rhizobium etli, Rhizobium leguminosarum, Rhizobium															3		
Rhododendron																	
Rice					10				1	17							
Rubus idaeus			5											3			
Russian wildrye		1															
Soy	31	2		13	156		12	13	38	14		14			42		
Squash		1		1			3		1	4		3					
Strawberry			5														
Sugar Cane										9							
Sunflower																	
Sunflower								1									
Sweet Gum							5										
Sweet Potato							2						1				
TEV																	
TMV																	
Tobacco		2					4		4	1		18		1	3		
Tomato	8		9		7		1			1		4			6		
Walnut																	
Watermelon																	
Wheat		2	5					19						20			
Xanthomonas																	

APPENDIX E:

National Data on Field Releases by Crop



INFREQUENTLY FIELD TESTED CROPS, 1987-2000
(crops used in five permits or less)

Allegheny Service Berry	Oat
American Chestnut	Onion
Belladonna	Papaya
Chrysanthemum	Pea
Chicory	Pineapple
Coffee	Plum
Cranberry	Raspberry
Eggplant	Spruce
Geranium	Sweetgum
Gladiolus	Sweet Potato
Kentucky Bluegrass	Texas Gourd

APPENDIX F:

Percentage of Field Tests Conducted Containing Confidential Business Information

Year	Number Containing CBI	Total Number of Permits	Percent of CBI Permits
1987	0	9	0%
1988	0	18	0%
1989	0	38	0%
1990	7	58	12.10%
1991	16	107	15%
1992	36	150	24%
1993	115	306	37.60%
1994	218	593	36.80%
1995	235	681	34.50%
1996	247	626	38.20%
1997	385	744	51.70%
1998	666	1086	61.30%
1999	641	987	64.90%
2000	609	931	65.40%
Totals	3175	6334	50.13%