Report on Contamination by Genetically Engineered Papaya in Thailand

Greenpeace Southeast Asia
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It has been two years since facts were made public that a research station under the Thai Government had illegally sold and distributed genetically engineered (GE) contaminated papaya seeds to farmers. Subsequent investigations by an independent constitutional body and by NGOs found GE contamination in the environment. These revelations compelled the government to admit the contamination of papaya farms, after which it ordered the destruction of GE papaya trees in the experimental plots.

Unfortunately, necessary steps to decontaminate Thailand’s environment have not been taken. The Department of Agriculture (DOA), which started the controversial genetic engineering research in question is ironically the same agency mandated to enforce the quarantine on GE papaya. The DOA claims that it has completely destroyed all GE papaya that has spread outside of the research station. However, later investigations by Greenpeace as well as by other independent organizations like the National Human Rights Commission of papaya plots on farms that received suspected GE contaminated seeds proved otherwise. Over the past few years, GE papaya contamination has been discovered in several provinces.

Despite this, the DOA still refuses to deal with the ongoing contamination of Thai papaya farms. Instead, the agency is seeking a reversal of an earlier cabinet resolution banning all GE field trials in an effort to cover up for its sins and legitimize the spread of GE papaya to the environment.

GE papaya has never undergone proper assessments either for human food safety or environmental risks. As such, the Thai people run the risk of eating GE papaya without their knowledge and consent, thereby serving as guinea pigs for an experiment that is going out of control.
1. Basic Information on Papaya

Papaya is a crop commonly grown in more than 50 countries in the tropics and subtropics, including the United States, Thailand, Taiwan, the Philippines, Brazil and the Caribbean.

Though an annual plant, well-tended papaya trees can last for up to 20 years. A papaya tree could be male, female, hermaphrodite (having both sexes), and reproduction happens naturally through cross-pollination. Large numbers of seeds in each papaya fruit increase the chances for the plant to spread in the environment.

Papaya fruits are eaten ripe in most places except Thailand, where immature or green papaya is also used as a main ingredient in somtam, a favorite dish for most Thais.

In Thailand, papaya trees are generally grown on the boundaries of farms or rice fields, in spaces near houses or backyard gardens for household consumption. They are also cultivated in plantations to supply factory production. According to the Department of Agricultural Extension\(^1\), the total area of land for papaya farming in 2003 was 139,835 rai (22,373.6 hectares), with 108,338 rai (17,334 hectares) already in production and with a total output of 306,474 tons. Most papaya production in Thailand is consumed domestically.

Image 1: A Thai papaya tree
Source: Greenpeace Southeast Asia
Thailand has exported papaya products mainly as canned fruits, processed papaya in airtight containers and raw papaya. Figures from the Thai Customs Department in 2005 show that the export value of canned fruit cocktail, of which papaya comprises 25% of the total ingredients, totaled 3,222 million baht or 78.69 million USD. The major importers were the US (2,051 million baht equivalent approximately to 50.09 million USD), Japan (209 million baht, approx. 5.10 million USD) and Canada (170 million baht, approx. 4.15 million USD).

The total exports of raw papaya in the same year was 1,715,034 kg in weight and 17,845,435 baht in value, with China (1,224,519 kg), Hong Kong (422,238 kg) and the United Arab Emirates (22,055 kg) as the major buyers. The export of processed papaya in airtight containers amounted to 3,541,952 kg with the total value of 129 million baht (3.15 million USD). The major importers of the products were the Netherlands (875,534 kg), the US (508,702 kg) and Greece (290,308 kg).

2. State of GE papaya research in Thailand

Research on GE papaya in Thailand has been undertaken by three state agencies:

The Department of Agriculture (DOA) under the Ministry of Agriculture and Cooperatives

US-based Cornell University has been helping the DOA in developing GE papaya which is resistant to the ringspot virus (PRSV) using local Thai papaya varieties, namely Khaekdam and Khaeknun a as well as the Khon Kaen strain of the Thai ring spot virus. Seedlings and tissues of GE PRSV-resistant papaya were brought back to Thailand in May 15, 1997 and later planted in closed plots. Field trials were done on 11.5-rai (1.84 hectares) of land at the Horticulture Division of the Office of Agricultural Research and Development (Zone 3), located in Tambon Thaphra, Muang District of Khon Kaen Province. When it was discovered that GE papaya had spread into the environment from this research station, the Thai Government on September 15, 2004 ordered the destruction of all papaya trees in the trial plots.
Plant Genetic Engineering Unit (PGEU)
PGEU is an operation being run by the National Biotechnology and Genetic Engineering Center (BIOTECH) under the Ministry of Science and Technology. PGEU received cooperation from Kasetsart University-Kamphaengsan in Nakhon Pathom in its research to develop PRSV-resistant and delayed-ripening GE papaya using the Khaekdam variety and a Chiang Mai virus strain. The laboratory process was conducted at the Queensland University of Technonology in Australia. Field trials of the GE papaya had been carried out in Kasetsart University’s Kamphaengsaen campus.

Institute of Molecular Biology and Genetics (IMBG), Mahidol University
IMBG of Mahidol University has been undertaking research on GE PRSV-resistant papaya using the Khaekdam variety and a Ratchaburi virus strain since 1994. This research has been conducted entirely in Thailand, and field trials are currently being done at the institute’s experimental plot.

3. Laws Governing Genetically Engineered Organisms in Thailand
In Thailand, GE crops are regulated by the Plant Quarantine Act 1964 (amended in 1999) and the 3 April 2001 Cabinet Resolution, which prohibits all field trials of GE plants.

3.1 The Plant Quarantine Act 1964 designates GE crops as prohibited plants, which means their import or transit throughout the country are prohibited. This restriction can be waived by permission from the DOA Chief only for the purpose of experimentation and research. In case of GE contamination spreading out into the environment, the Department of Agriculture is responsible for tracking down and destroying any contaminated plants. GE papaya is listed as No. 37 on the list of plants that are prohibited under this act.

3.2 The 3 April 2001 Cabinet Resolution which bans all types of GE field trials in the country, was issued under pressure from civil society following controversy over the escape of genetically engineered BT cotton from field trial plots.

The aforementioned rules and regulations clearly prohibit any commercial production of GE crops and permit research only in laboratories or greenhouses. Despite this,
proponents and pushers of genetic engineering have deceitfully interpreted and pushed the continuation of field trials in a way that would prohibit field trials done on farmers’ fields but not those undertaken by allied educational institutions or government agencies on their own experimental plots, even if such open experiments have resulted in the uncontrolled dispersal of GE papaya into the environment.

4. Spread of GE Papaya and Contamination in the Environment
Of all the known GE papaya field trials in Thailand, the one conducted at the Khon Kaen research station posed the highest risk of environmental contamination given the large field trial area – 11.5 rai (1.84 hectares) – and the experiment’s proximity to the station’s non-GE papaya plots from which seeds were collected for distribution to the public. Only barbed wire fences, widely spaced rows of banana trees and a road separated the two plots. These barriers were obviously inadequate in preventing cross-pollination between GE and non-GE papaya varieties, a process that takes place with the aid of the wind, birds or insects.

To make matters worse, the research station is one of the country’s largest centers for the distribution of papaya seeds, which could be bought directly either from the station or via mail order. The station also provided a large number of papaya seeds and seedlings to other government agencies and farmers’ groups which in turn redistributes them to small farmers.

On July 27, 2004, Greenpeace revealed that the Khon Kaen research station had sold or distributed GE-contaminated papaya seeds and seedlings to the public. To support its claim, Greenpeace provided two receipts documenting the purchase of Khaedam Thaphra papaya seeds from the station on June 8 and July 17, 2004. Testing by GeneScan, a laboratory based in Germany showed that the two sets of seed samples purchased from the research station at different times were GE contaminated. In addition, another set of tests showed two samples of seeds collected from a one-year old papaya tree to be GE contaminated. The farmer of the papaya tree in question had obtained the seeds from the research station in 2003.
These constituted positive proof that the GE papaya which originated from the government’s very own field trial plots were contaminating the environment through the Khaekdam Thaphra papaya seeds and seedlings that the Khon Kaen research station was distributing to the public and small farmers.
GM papaya likely in ‘at least 10 provinces’

Project head disagrees with NHRC claim

KULIDA SAMABUDHI

The National Human Rights Commission believes that genetically-modified papaya has been grown in at least 10 provinces, including Bangkok.

“It is likely contamination has occurred beyond Khon Kaen province because the Agriculture department has distributed papaya seeds and seedlings to more than 2,600 farmers nationwide,” commission chairman Prof Suree Chumrak told a press conference yesterday.

The commission suspects GM papayas are being grown in Kalasin, Chaiyaphum, Nong Bua Lamphu, Roi Et, Ubon Ratchathani, Udon Thani, Mahasarakham, Mukdahan, Loei, Petchabun, Lo Buri, Rayong, Ratchaburi and Bangkok.

It bases this assumption on an Agriculture Department list of those who received papaya seeds from the department’s Khon Kaen Horticultural Research Station.

Mr Suree also revealed a fresh case of GM papaya contamination in Khon Kaen’s Phu district.

Two weeks ago, papaya samples were collected from the plantations in Phu for testing at Mahidol University. One sample tested positive for genetically modified organisms.

Mr Suree urged Agriculture Minister Somkiat Phsothum to investigate the recent case.

The finding brought the number of confirmed GM-papaya orchards to three, following earlier discoveries by Greenpeace and the Agriculture Department.

The commission’s announcement was made as workers cut down more than 200 GM papaya trees at the research station, the suspected source of the GM contamination, on the orders of Mr Sommai.

The department had also eradicated all papaya trees at a farm owned by Samorn Nakong, whose papaya trees were found to contain GMOs.

Mr Suree blasted the department for covering up information about its GM crop experiments and for its sluggishness in tackling GMO leakage from the research station.

“Such non-transparency and negligence shows the concerned agencies are unaware of the complexity and danger of genetic engineering technology, which could cause grave damage to the country’s agricultural sector and biological resources,” he said.

However, Vilai Prasatsiri, director of the Khon Kaen research station, said GM papaya project chief disagreed that transgenic papayas could spread outside Khon Kaen province.

“Contamination does not occur that easily,” said Mrs Vilai.

She said the leakage was not the result of human errors.

“The experiment has been carried out under stringent controls. It is impossible for our staff to distribute GM papayas to farmers,” said Mrs Vilai.

The contamination was likely to have occurred naturally.

Mrs Vilai is facing a disciplinary probe for alleged negligence involving the leakage of GM papaya seeds from the station.

She vowed to go ahead with the research on GM papaya in the laboratory and greenhouse after the experimental field was virtually shut down yesterday.

She said the shutdown caused only a minor problem for researchers because they had already obtained sufficient data on the bioactivity of the transgenic papaya.

She said the incident had prevented the department from taking a memorandum of understanding to share benefits from GM papaya sales with Cornell University, a co-inventor of transgenic papaya resistant to ring spot virus in Thailand.

The memorandum was to be signed this week, but has been postponed indefinitely. “We have missed a chance to benefit from producing and selling GM papayas,” said Mrs Vilai.

Meantime, Tripho Juahit, Democrat MP from Nakhon Si Thammarat, demanded that Mr Sommai take responsibility for the leakage and resign as agriculture minister. He said the news had already caused great damage to GM products as some importers of Thai pollinate in Thailand.

Image 2: Khon Kaen Research Station workers destroyed GE papaya field trial inside the station on 15 September 2004 with no protection.

Source: Bangkok Post 16 Sep 2004
5. Investigation into Contamination caused by GE Papaya

Following the disclosure by Greenpeace, government agencies, independent bodies, NGOs and farmers groups began investigating the alleged contamination and reported their own findings which are briefly discussed below.

5.1 The Department of Agriculture

The DOA which supervised the controversial research, initially denied any breach of the standing government restrictions to prevent contamination. However, under mounting pressure and complaints from the National Human Rights Commission (NHRC), NGOs and farmer groups, the DOA took steps to investigate the case by collecting samples from farms which received or bought the seeds from the research station. Its own investigation found GE papaya trees on a farm one kilometer away from the station, prompting the issuance of a subsequent order to have the said trees destroyed on September 14, 2004. Later on, the Department agreed to disclose the list of recipients and buyers of Khaekdam Thaphra seeds from the research station. The list showed that the station had distributed the seeds and seedlings to 2,669 people in 37 provinces in 2003-2004 as shown in the table 8 below.

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of Provinces</th>
<th>Number of Recipients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>10</td>
<td>41</td>
</tr>
<tr>
<td>Northern</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Southern</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Northeastern</td>
<td>19</td>
<td>2,608</td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
<td>2,669</td>
</tr>
</tbody>
</table>

Source: Academic paper (papaya), Department of Agriculture, April 2005, p.65

Most of the recipients received 5-100 seedlings each. Each person was given or sold seeds amounting to 100 grams, approximately 5,000 seeds. However, the seeds were also given in much larger numbers to other government agencies for further distribution. The Office of Agriculture and Cooperatives of Khon Kaen Province, for instance, received 3,000 grams of the seeds while its counterparts in Muang District and Ubonrat District got 1,000 and 4,000 seedlings respectively. 9
The Club for Dissemination of Agricultural Knowledge, a private agricultural extension group located in Pichit Province, was the biggest recipient of GE-contaminated papaya seeds, obtaining 3,500 grams of Khaekdam Thaphra seeds. The group placed announcements in farmer’s magazines promising 20 Khaekdam Thaphra seeds in exchange for completed questionnaires which sought to gather opinions on GE papaya. The group also sold the seeds to any interested person by mail order. Documents gathered by the NHRC showed that the group bought seeds of Khaekdam Thaphra 1-2 varieties from the research station at 1,200 baht/kg. The seeds were then distributed to the public including a list of 1,000 farmers.

The evidence gathered from the DOA and independent bodies were enough to prompt Agriculture Minister Somsak Thepsuthin to order the destruction of papaya trees in the Khon Kaen research station’s field trial plot on September 15, 2004.
Map 1: Areas which may be contaminated with GE papaya & areas where GM papaya contamination was found.
Afterwards the Ministry of Agriculture and Cooperatives set up a committee to investigate the case, but it met only once and never produced any findings or recommendations related to the contamination issue. 11

In his report to the Permanent Secretary of the Ministry of Agriculture and Cooperatives dated November 11, 2004, then DOA Chief Chakarn Saengraksawongse concluded that “the department had to destroy papaya trees in compliance with the Plant Quarantine Act 1964 (amended in 1999). 329 of 8,912 samples collected from 85 farms were found...
contaminated. Papaya trees on 83 of these farms have already been destroyed. Samples have been recollected from the two remaining farms. Compensation has been advanced to the 83 farmers at 40 baht for each tree.”

In spite of this admission the DOA has so far failed to follow up and take further action to investigate and stop the spread of GE papaya distributed by other government agencies and the Club for Dissemination of Agricultural Knowledge. Despite reports by Greenpeace and the NHRC informing the agency of new GE contamination found among papaya trees on the farms other seed recipients, the DOA has refused to renew its efforts to follow up and destroy GE-contaminated papaya. Instead it has proposed that the Cabinet scrap the ban on GE field trials imposed by the 3 April 2001 resolution.

In a deplorable turnaround, DOA Chief Adisak Srisappakij claimed that “there is little chance to be able to determine what consequences – positive or negative – GE papaya will have on humans and the environment because information is lacking. If (the research) is further delayed and not pushed ahead, in the future Thailand will fall behind its neighboring countries.”

5.2 The National Human Rights Commission

The NHRC is an independent body established by the Constitution to investigate and monitor violations of human rights; prepare an annual report on the situation of human rights for the Parliament, the Cabinet and the public; and make recommendations to the government accordingly. The NHRC has appointed a subcommittee to deal with issues concerning biological resources including those related to genetically engineered organisms (GE organisms).

In the wake of initial reports on GE papaya, the NHRC expressed concern that contamination by GE papaya into the environment could become a serious violation of farmers’ rights, consumers’ rights, and rights related to environmental, economic, social and cultural issues. Consequently, the agency has set up an ad hoc committee to investigate the contamination and spread of GE papaya.
The committee made its first fact-finding trip to collect samples in Khon Kaen on August 25, 2004. In a letter addressed to the Prime Minister, the committee reported that “samples of leaves and seeds were collected from 15 (papaya) trees planted in three farmers’ plots for tests on their genetic make-up by the laboratory at the Institute of Molecular Biology and Genetics. The testing found one of the samples genetically engineered. It can be concluded that the problem of GE contamination in the environment has arisen even though it has been unable to assess the scope of this contamination due to the lack of cooperation from the Department of Agriculture in collecting samples from its research station.” The letter further recommended that all field trials on GE papaya be discontinued and that papaya trees in experimental plots be destroyed. This letter subsequently led to the Agricultural Minister’s directive on September 15, 2004 ordering the destruction of GE papaya in field trial plots at the research station.

Not long after, the NHRC received complaints and reports that more GE papaya were discovered in farms in many other provinces, prompting the ad hoc committee to undertake a second fact-finding trip between July 14 and 17, 2005, during which 31 samples of leaves and seeds were gathered from papaya trees on six farms in four provinces – Rayong, Mahasarakham, Chaiyapum and Kalasin. DNA testing by IMBG and BIOTECH labs found GE papaya in 11 of the 31 samples. The six farmers reported that they had never been contacted by DOA officials for any inspection.13

Aside from carrying out fact-finding missions, the NHRC also sent letters to the DOA twice requesting information on GE papaya research and the list of farmers which received papaya seeds and seedlings from the research station. These letters were ignored by the DOA. Consequently, the NHRC wrote to the Agriculture Minister complaining about the lack of cooperation from the DOA. The NHRC also sent letters to the Prime Minister twice informing him of the results of its investigations and their recommendations.

On December 8, 2005, the NHRC ad hoc committee lodged a complaint with the National Office of Police against former DOA chief Chakarn Saengraksawongse and officials of the Khon Kaen research station for negligence of duties specifically in relation to their failure to follow through with the investigation and destruction of GE papaya.
papayas, thereby allowing the controversial crop to spread to other farms in violation of the Plant Quarantine Act.¹⁴

5.3 Greenpeace Southeast Asia
Greenpeace Southeast Asia began its campaign against GE papaya in Thailand in July 2003 by sending letters to relevant government agencies and officials including the Office of the Prime Minister, demanding the termination of field trials on GE papaya in the country and pressing for the full disclosure of information on GE papaya to consumers, farmers and academics.

As mentioned earlier, on July 2004 Greenpeace revealed that Khaekdam Thaphra papaya seeds purchased from the Khon Kaen research station tested positive for GE organisms, triggering investigations which later led to the order by the Ministry of Agriculture and Cooperatives to destroy GE papaya in the station’s field trial plots as well as in other areas where contamination has been found.

To continue its efforts to halt the spread of GE papaya in the environment, Greenpeace set up its GE Papaya Patrol in 2005 with the aim of gathering additional information and samples from the farms of 68 farmers listed as recipients of Khaekdam Thaphra seeds from the Khon Kaen research station. Testing by Genescan of 39 samples secured through these efforts, revealed GE contamination in 8 samples – specifically those collected from Kamphaengphet, Rayong, Kalasin, Chaiyaphum and Mahasarakham.¹⁶ The owners of the said farms reported they received no communication nor assistance from any government agency looking into GE papaya contamination.

Based on the foregoing, it is quite clear that the DOA was not really interested in investigating and stopping the spread of GE papaya in the country.

5.4 Biothai and farmer groups¹⁷
Biothai, Confederation of Consumer Organization (Thailand) and the Alternative Agriculture Network also carried out a joint investigation from September 8-20, 2004, during which 28 samples were collected from Khon Kaen (6), Ubonratchathani (5), Chachoengsao (3), Sakon Nakhon (2), Ratchaburi (5), Chumphon (1), and supermarkets in Bangkok (6). Later testing by IMBG and Biotech found GE contamination in 2 of the samples from this investigation: one from the farm of Khon Kaen farmer Kan Kuinongbua, who obtained 200 papaya seedlings from the research station, and the other from a village in Tambon Nonkalen of Samrong District in Ubonratchathani, where villagers were given free seedlings in celebration of a national holiday.

6. Consequences of GE Contamination in Papaya

On the Environment
There is already evidence that contamination of non-GE papaya by genetically modified varieties is occurring. Tests on samples taken from a papaya tree in Kamphaengphet, of the “Florida-tolerant variety”, a non-GE variety, showed for example that only its seeds were GE positive, but not the leaves – an indication that cross pollination with GE papaya is taking place. The farmer obtained the parent seeds of “Florida-tolerant” papaya together with those of the Khaekdam Thaphra variety from the Khon Kaen research station in June 2003.

At another papaya farm, the NHRC reported that its investigations showed cross pollination between GE and non-GE papayas in plots more than 30 m. away from each other.

On Farmers’ Rights
Cornell Research Foundation Inc, which was provided with Thai papaya varieties and strains of virus by the DOA for its research, has already registered patents on the GE PRSV-resistant papaya it has developed. In order to use the patented papaya, Thailand is required to sign a memorandum of understanding (MOU) on benefit sharing with the patentee, the Cornell Research Foundation Inc. Not only would Thai farmers’ rights to grow non-GE papaya be violated by unwanted and unknown contamination by GE
papaya, they also run the risk of facing patent right claims from patentees over the contaminated papaya that they did not want in the first place.

Image 4: A US Patent showing that Cornell Research Foundation owns the GE Papaya
Source: www.uspto.gov

On Health

Preliminary lab tests found the presence of tetracycline-resistant genes in DOA’s GE papaya. One of the Thai scientists involved in the Cornell research, Dr. Nonglak Sarinthu, confirmed that tetracycline-resistant genes were inserted in the process of developing the papaya. The presence of this antibiotic resistance gene in the papaya is against international food safety standards including Codex’s Guideline for the Conduct of Food Safety Assessment of Foods Derived from Recombinant-DNA Plants, which specifically recommends against the use of antibiotic-resistant genes in the production of human food. Directive 2001/18/EC of the European Parliament and of The Council of 12 March 2001 stipulates that the use of antibiotic-resistant genes in commercial GE organisms end by December 31, 2004 and in field trials by December 31, 2008. The European Food Safety Authority clearly states that antibiotic resistance gene such as tetracycline resistance should not be present in GE crops placed on the market or used in field trials.
On Exports
In Japan and the 25 member states of the European Union, no GE crop is allowed to be imported or used in food without prior approval. Every genetically engineered crop has to go through an approval process before they could be imported into Europe for example. So theoretically, even if the EU approves importation of Hawaiian GE papaya in the future, such a permit would not include Thai GE papaya. Thailand would need to apply for an separate approval even if some of the foreign genes present in the Thai papaya are similar to the foreign genes in the Hawaiian papaya.

In other developed countries only the US, which produces GE Hawaiian papaya and Canada allow the import of Hawaiian GE papaya.

GE contamination of papaya would hurt Thailand’s papaya exports. In August 2004, buyers in EU and Australian, including one of the world’s biggest supermarkets based in Europe, delayed their importation of papaya and fruit cocktail products from Northern Food Co. (a Thai based producer and exporter of fruits) and asked for internationally recognized GE organism free certificates attached to each shipment of the company’s products. This is just an indication of the economic repercussions associated with the contamination of an export crop like papaya. Instead of creating new markets, contamination increases the prospects of being shut out from some of the world’s biggest markets for agricultural produce.

7. Recommendations
7.1 Immediate measures should be taken by the government, particularly the DOA to connect with farmers on the list of 2,669 recipients of papaya seeds and seedlings from the Khon Kaen research station – with the aim of stopping the spread of GE-contaminated papaya into the environment. This action should be extended to include the recipients of seeds or seedlings from government and private institutions including the Club for Dissemination of Agricultural Knowledge.

7.2 The government should remain firmly committed to the 3 April 2001 Cabinet Resolution, banning all types of GM field trials in the country. The escape of GE papaya from the experimental plots belies the responsible agencies’ claim that measures of
international standards have been taken to prevent the breach of safety restrictions of genetic engineering research. In addition, Thailand still lacks effective measures to control and eradicate GE contamination in the environment. Removing the ban on field trials would amount to widespread GE contamination.

7.3 Investigations should be renewed to find out and hold accountable those responsible for the spread of GE papaya from the research station into the environment.

7.4 As a Party to the Cartagena Protocol on Biosafety, Thailand’s legislation concerning biological safety must conform with the precautionary principle and other principles, stated in the agreement. These principles would help prevent the country from becoming a dumping ground for GE organisms from other countries. It also obliges Thailand to ensure that any GE organisms developed and released in its territory does not threaten the food and environment of other countries.

Reference
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6 Chakarn Saengraksawongse, “Research on GM Papaya by the Department of Agriculture” in Papaya, Department of Agriculture, Ministry of Agriculture and Cooperatives, April 2005, p.62-63
9 The list of recipients and buyers of Khaekdam Thaphra seeds 2003-2004, Department of Agriculture, Ministry of Agriculture and Cooperatives
12 “Cabinet to be asked to reconsider field trials on GM papaya in December,” Matichon Daily, November 24, 2005, p.17.
14 Police to step up probe into GM papaya,” Bangkok Post, December 10, 2005, Section 1, p.4.
15 Bangkok, Nonthaburi, Rayong, Kamphaengphet, Kanchanaburi, Petchaburi, Suphanburi, Nakhon Ratchasima, Mahasarakham, Khon Kaen, Kalasin, Udonthani, Nongbualamphu, Chaiyaphum, Nong Khai,
Srisaket, Surin, Lopburi, Yasothorn, Mukdaharn, Suratthani, Chumphon, Petchabun, Nakhon Panom, Sakon Nakhon, Nakhon Pathom, Prachinburi, Chachoengsao, Pichit, Loi, Buriram, Roi-ed, Samutprakarn, Phayao, Chiangrai, Ratchaburi and Amnatcharoen.

17 http://www.biothai.net/autopage1/show_page.php?t=2&sl_id=48&amp_id=48
19 On May 12, 2004 Cornell Research foundation Inc was integrated into a new organization called The Cornell Centre for Technology, Enterprise &Commercialization (CCTEC)
20 US Patent No.6,750,382 “DNA constructs and methods to impart resistance to papaya ring spot virus in plants”, June 15, 2004
21 Nonglak Sarinthu, Ringspot Virus-Resistant Papaya Varieties, Division of Plant Diseases and Microbiology, Department of Agriculture, paper for lecture on genetically engineered papaya at Research Institute of Horticulture, Department of Agriculture on July 20, 2000
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