

# HERBICIDE TOLERANT CROPS

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## TYPES OF HERBICIDE – TOLERANT CROPS

**PLANTS RESISTANT TO AHAS HERBICIDE:**  
ALTERED ENZYME WITH DIRECT MUTAGENESIS

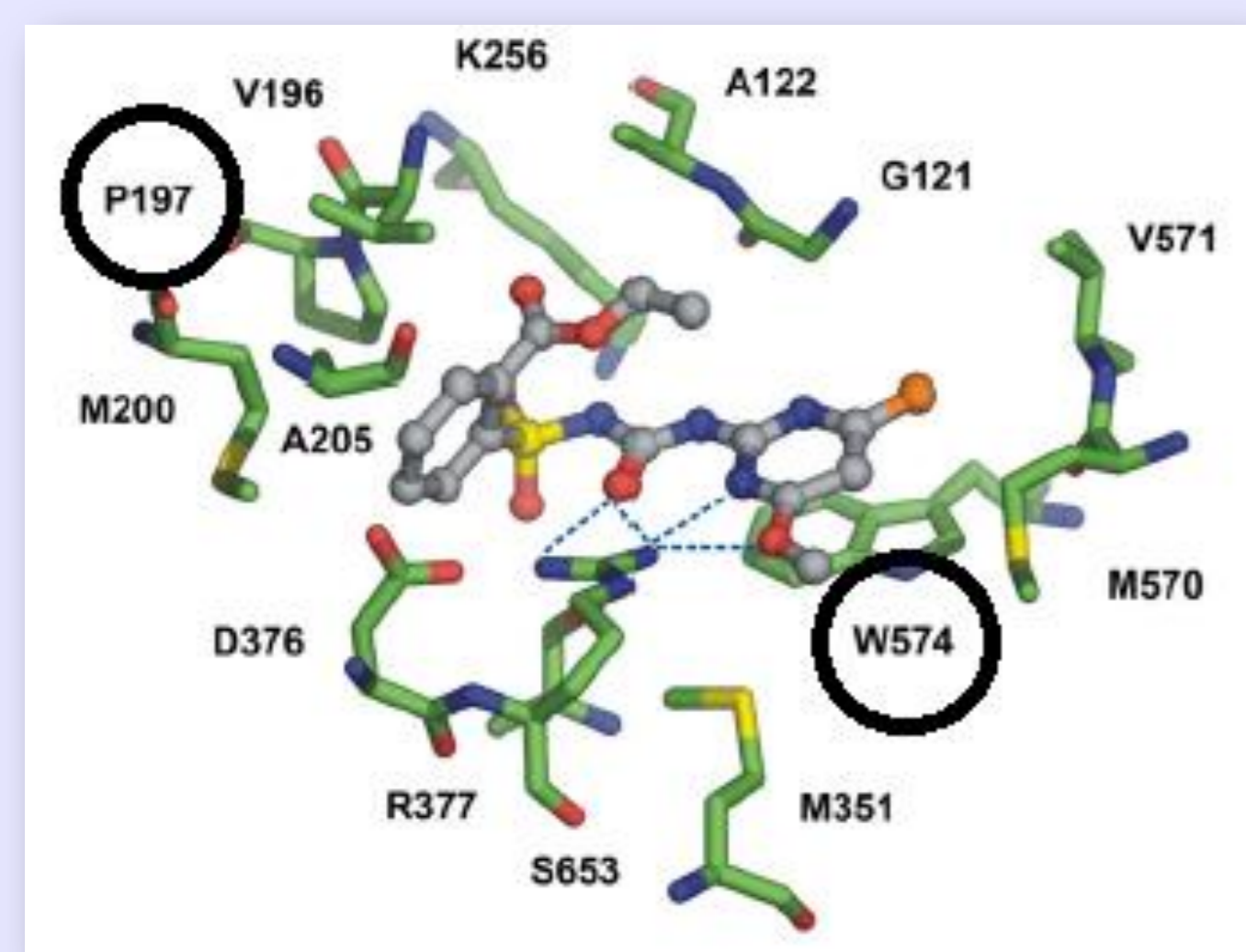


Figure 1: Direct site mutagenesis of the two most used modifications in Ahas tolerant herbicide crops

**PLANTS RESISTANT TO GLYPHOSATE:**  
VECTOR INSERTION OF *ARO A* AND *GOX* GENES LEADS THE PLANT ALTER THE ENZYME AND DETOXYFY GLYPHOSATE RESPECTIVELY

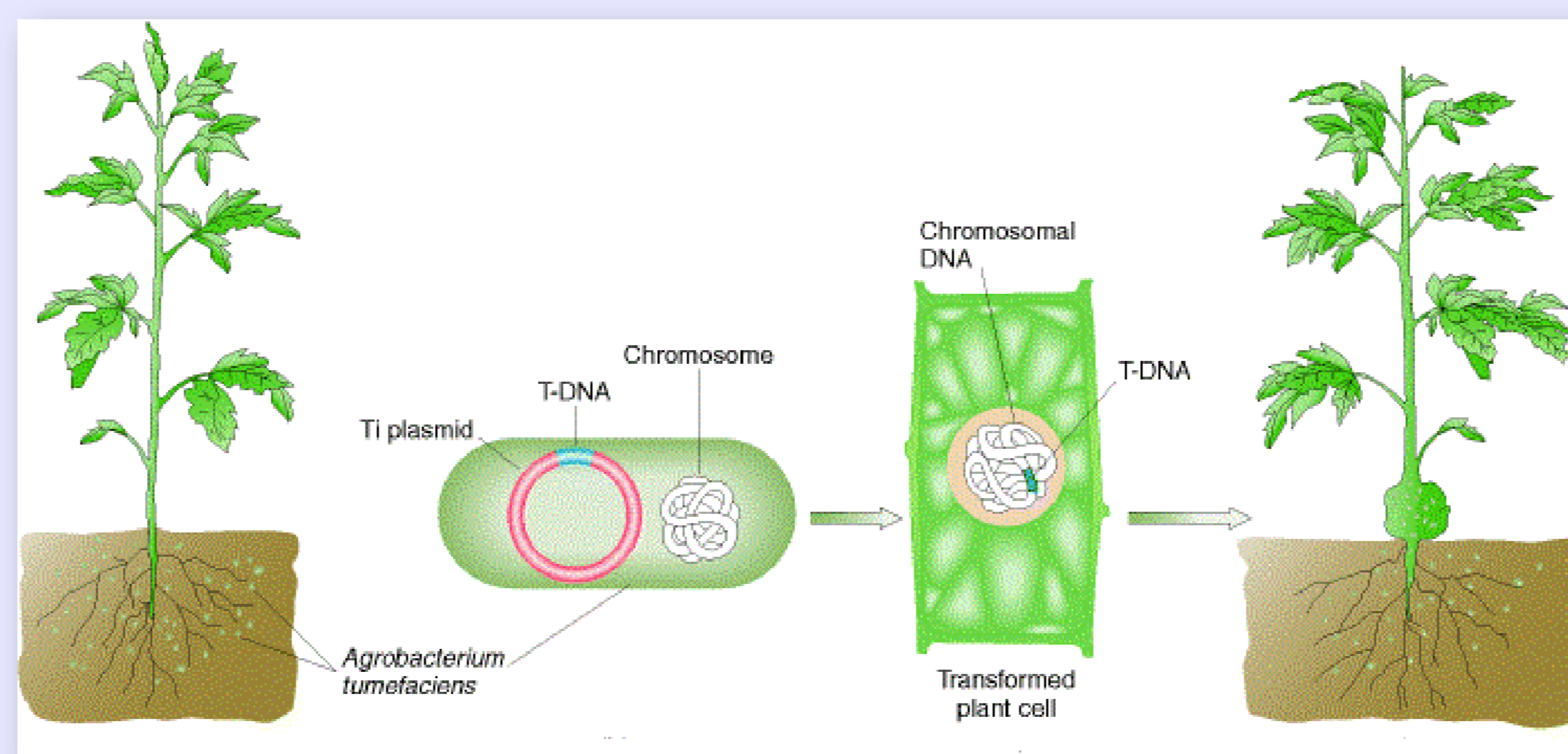


Figure 2: A vector with AroA and Gox genes were introduced to *A. Tumefaciens* for plant transformation

**PLANTS RESISTANT TO GLUFOSINATE:**  
VECTOR INSERTION WITH *BAR* OR *PAT* GENES LEADS THE PLANT DETOXYFY GLUFOSINATE

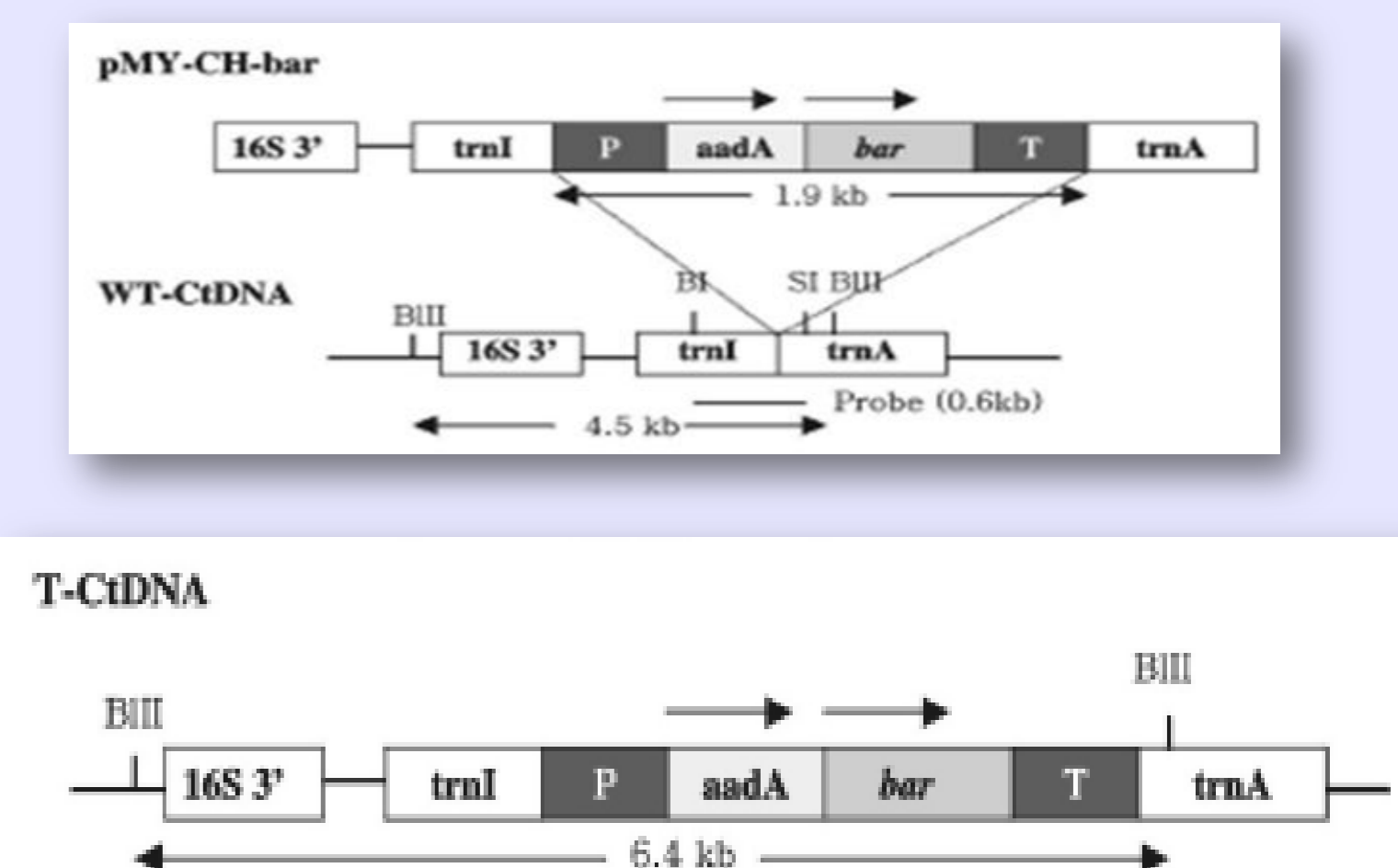


Figure 3: A vector with bar or pat genes were introduced to *A. Tumefaciens* for plant transformation

**Herbicide tolerant crops** are the most current modification in genetically modified crops. Among the GM events, the herbicide-tolerant soybean event GTS-40-3-2 has the highest approvals (52 approvals in 26 countries + EU-28). Although that facts, much countries ban their presence in their crops because of social and economic factors. Spain leads the transgenic cultivation in Europe with more than 30% of the cultivated field.

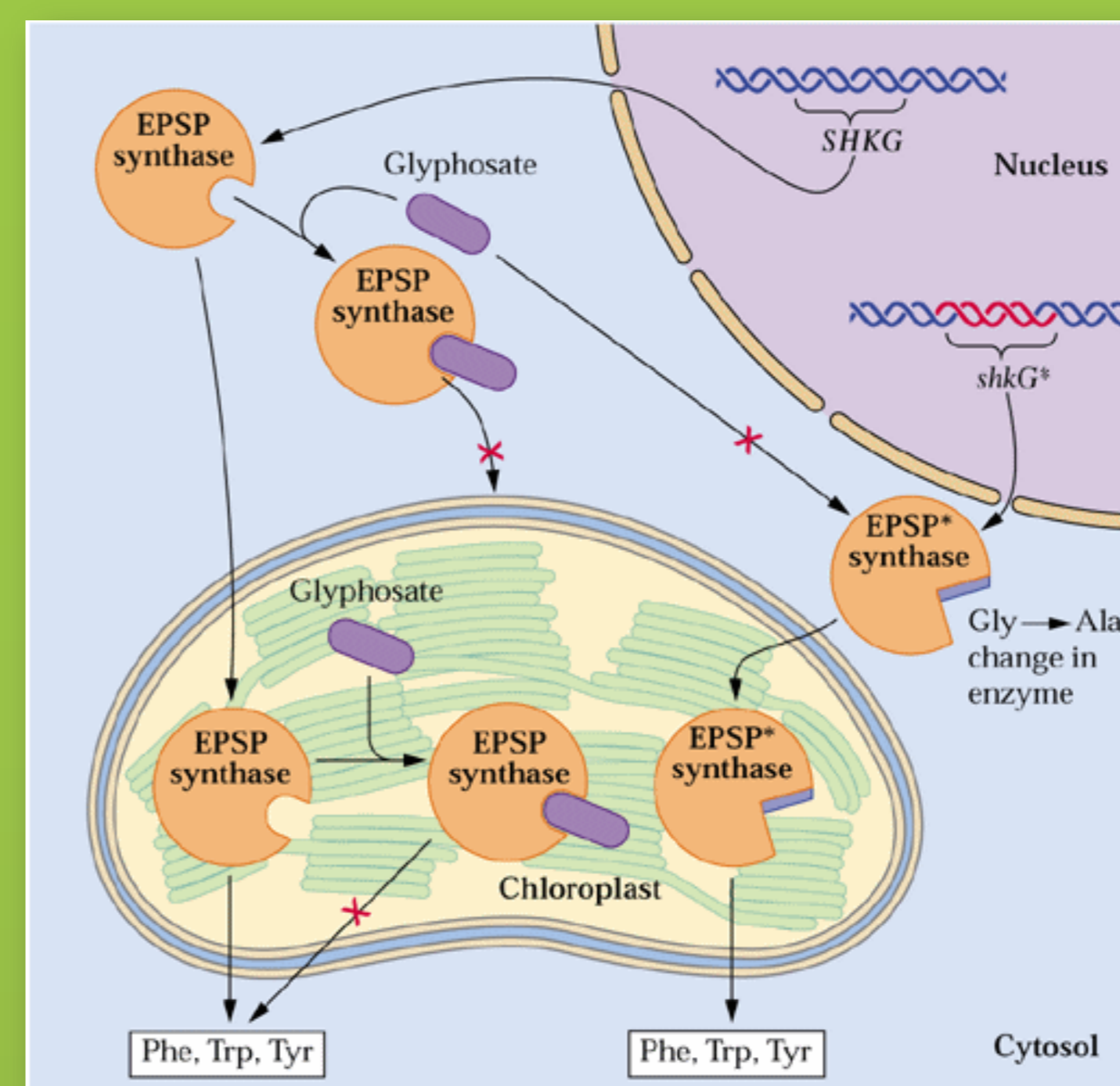
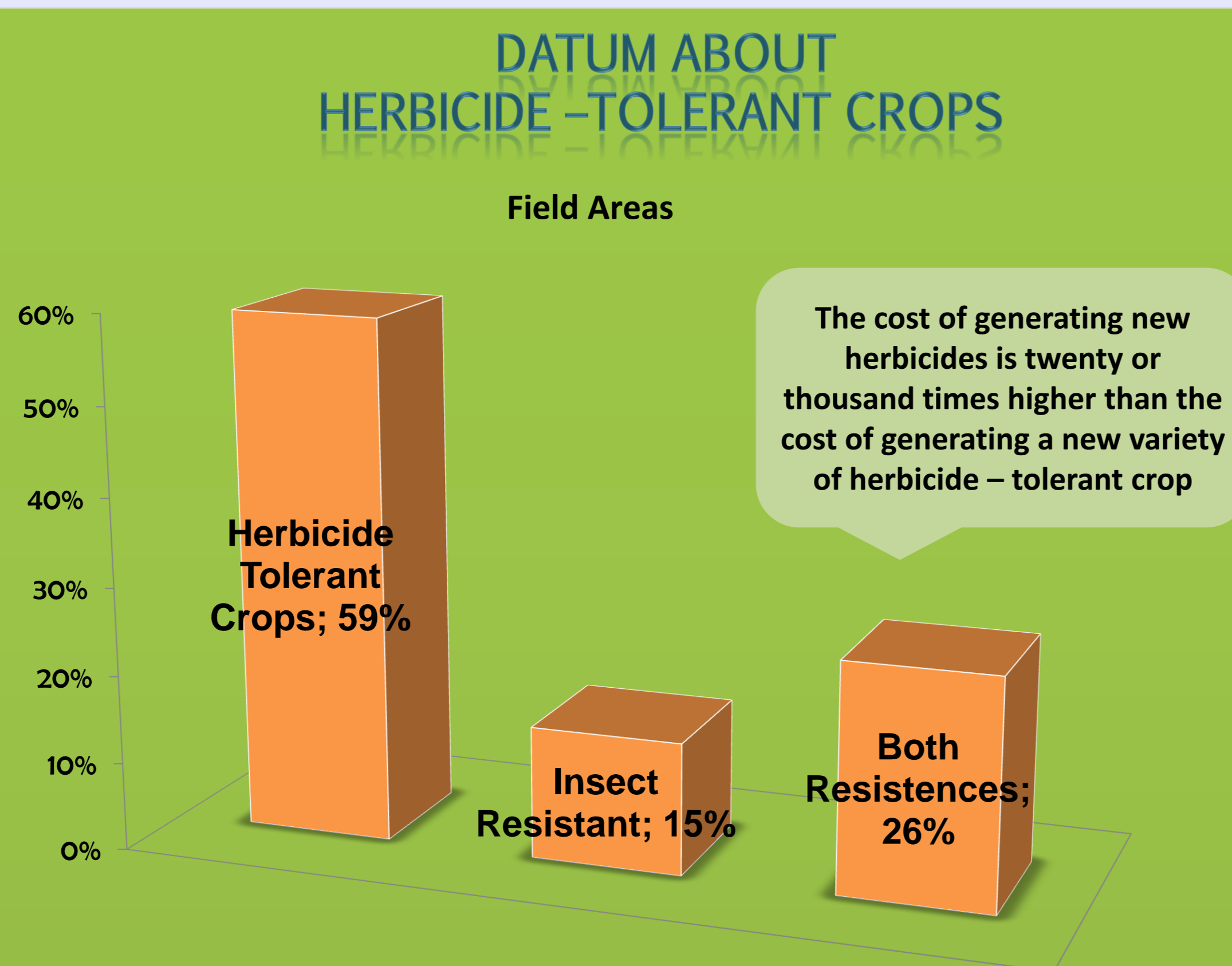


Figure 4: Herbicide inhibition of essential branched amino acid

**Herbicides** : substances used for killing unwanted plants. Most herbicides control weeds by targeting and inhibiting a protein or enzyme in plants consequently blocking the protein and essential amino acid synthesis.

- The herbicide must be:
1. Highly selective
  2. Act quickly and efficiently
  3. Rapidly degradable in environment
  4. Be cheap to produce and purchase.

EFSA centralizes the **GMO analysis** based in the prevailing directive 2001/18/EC that legislates the environmental release of GMO, and **regulation No 1829/2003** provides rules of traceability and labelling of GMOs and the traceability of food and feed produced from GMOs. Analysis are made “case-by-case” comparing the thousands of varieties existing with the transformed ones. They consider the “**Intended and Unintended effects**” of the genetic modification.



COST OF GMO APPROVAL:

USA:  
5 – 10 MILLION \$

EUROPE:  
10 – 20 MILLION \$

THE AIM OF THIS WORK IS:

To analyze the basic techniques for obtaining Herbicide Tolerant Crops, analyzing its applications and repercussions. Also, the work wants to study the current legal perceptions about Genetically Modified Crops, companies business with seeds and makes emphasis in one big problem affecting human health: **Herbicides.**



World Health Organization is warning about the **harmful effects of glyphosate** in human health. Recent investigations have demonstrated that ethoxylated alkylamines adjuvants can induce among others DNA damages. Tumours and pregnancy defects are now being related to the glyphosate presence.

**Brazil, Colombia, France and Netherlands** have been the first countries where glyphosate has been **banned**. Is It the end of that monopolistic commercial product?

There are many **interests** from **private companies** and **social organizations** for making that scientific approach a sweet product. Ones want to monopolize the market, others want funding pretending to ban these plants. This only leads to strong regulations hold by fear and social disapprovals.

**Who have made that business so sweet?**



Figure 5: Genetically Modified Crops labeling and bans around the world

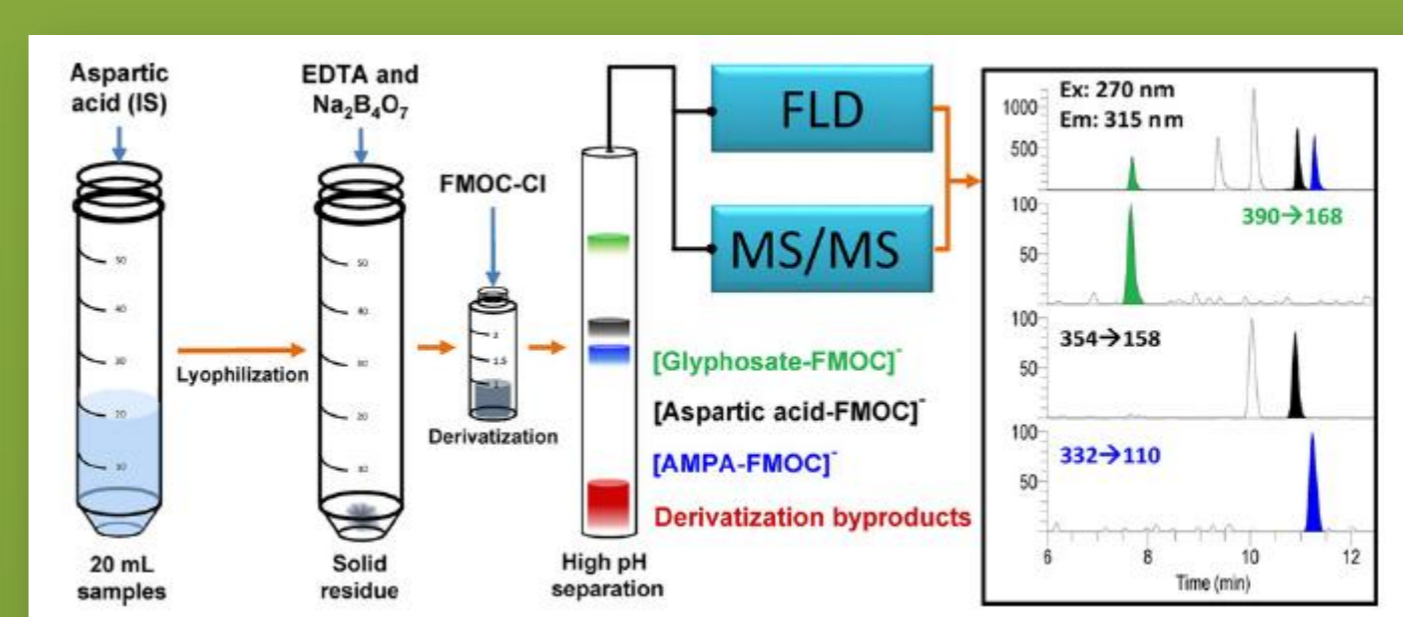


Figure 6: A specific method for glyphosate analysis in vivo.

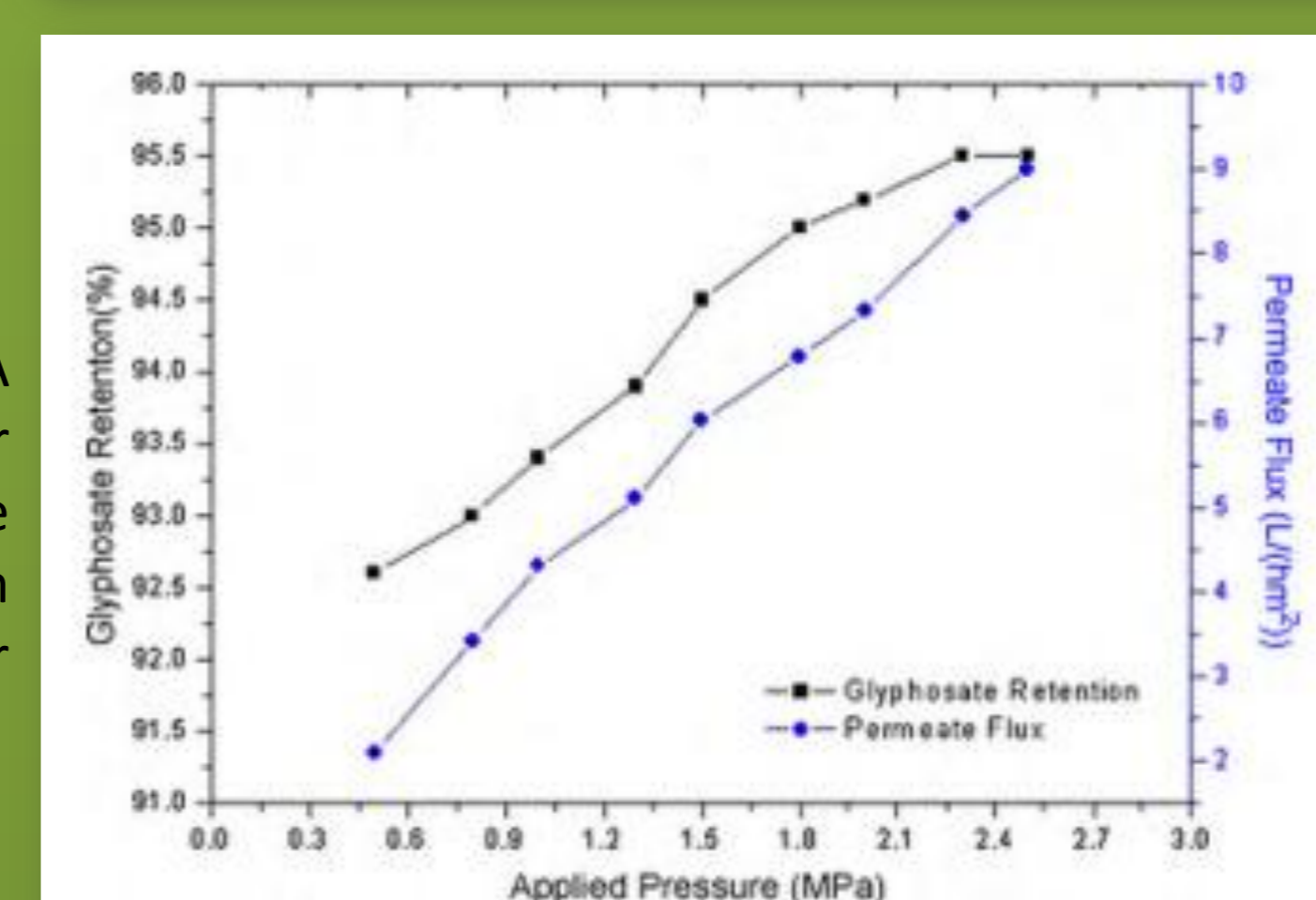


Figure 7: A method for glyphosate recovery from water

**New technologies** has been developed for solve to main problems:

▪ **The In Situ analysis persistence of glyphosate in water:** The basic techniques of liophilization and mass spectrometry allows to detect glyphosate concentrations in vivo.

▪ **The glyphosate recovery from water do to its solubility:** A mixed system of nanofiltration membranes and pressure driven pumps leads the pilot scale process to recover a huge concentration of the glyphosate dilute.

### SUMMARY AND FUTURE GOALS:

1. Develop herbicides less aggressive and harmful for human health and environment ;
2. Continue investigating for developing new plant varieties resistant to less harmful herbicides
3. Let world population to continue eating cultivated products although the huge population increase;
4. Fight against private companies and organizations whose aims only want to make plant biotechnology another commercial product.

### References:

Jiangnan Shen, J.H., Huiming Ruan, JiadeWang, Bart Van der Bruggen, *Techno-economic analysis of resource recovery of glyphosate liquor by membrane technology*. Desalination, 2014, 342: p. 118-125.  
Ramirez, C.E., S. Bellmund, and P.R. Gardinali, *A simple method for routine monitoring of glyphosate and its main metabolite in surface waters using lyophilization and LC-FLD+MS/MS. Case study: canals with influence on Biscayne National Park*. Sci Total Environ, 2014, 496: p. 389-401.  
WHO, *Short term and long term studies on Glyphosate*. 2014.

Tan, S., R. Evans, and B. Singh, *Herbicidal inhibitors of amino acid biosynthesis and herbicide-tolerant crops*. Amino Acids, 2006, 30(2): p. 195-204.