# BIOCULTURAL IMPACTS OF TRANSGENIC CROP RELEASE AT CENTERS OF ORIGIN AND DIVERSIFICATION: THE CASE OF MAIZE IN MEXICO

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**UCCS, UCCSNAL, ENSSER, TWA**

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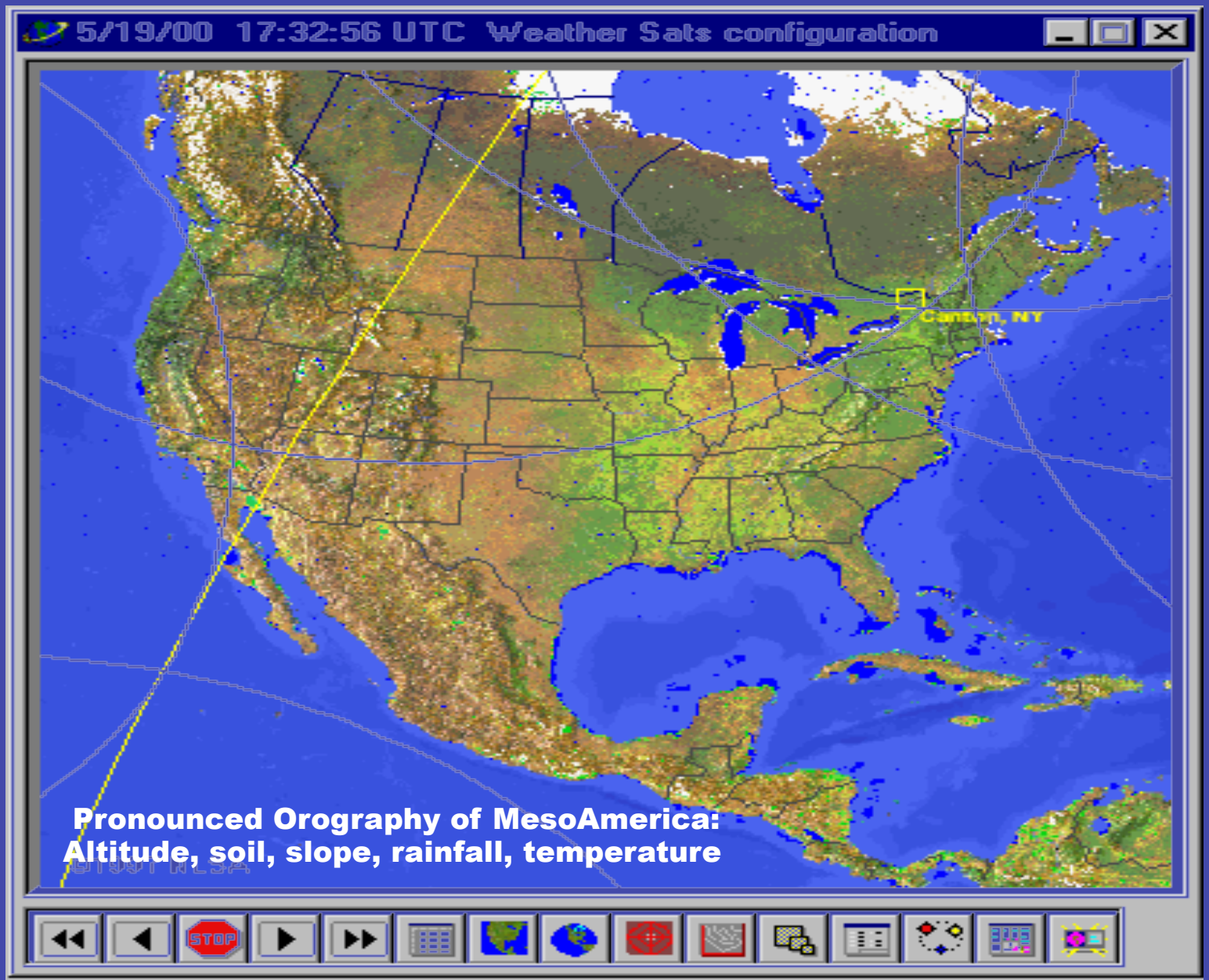
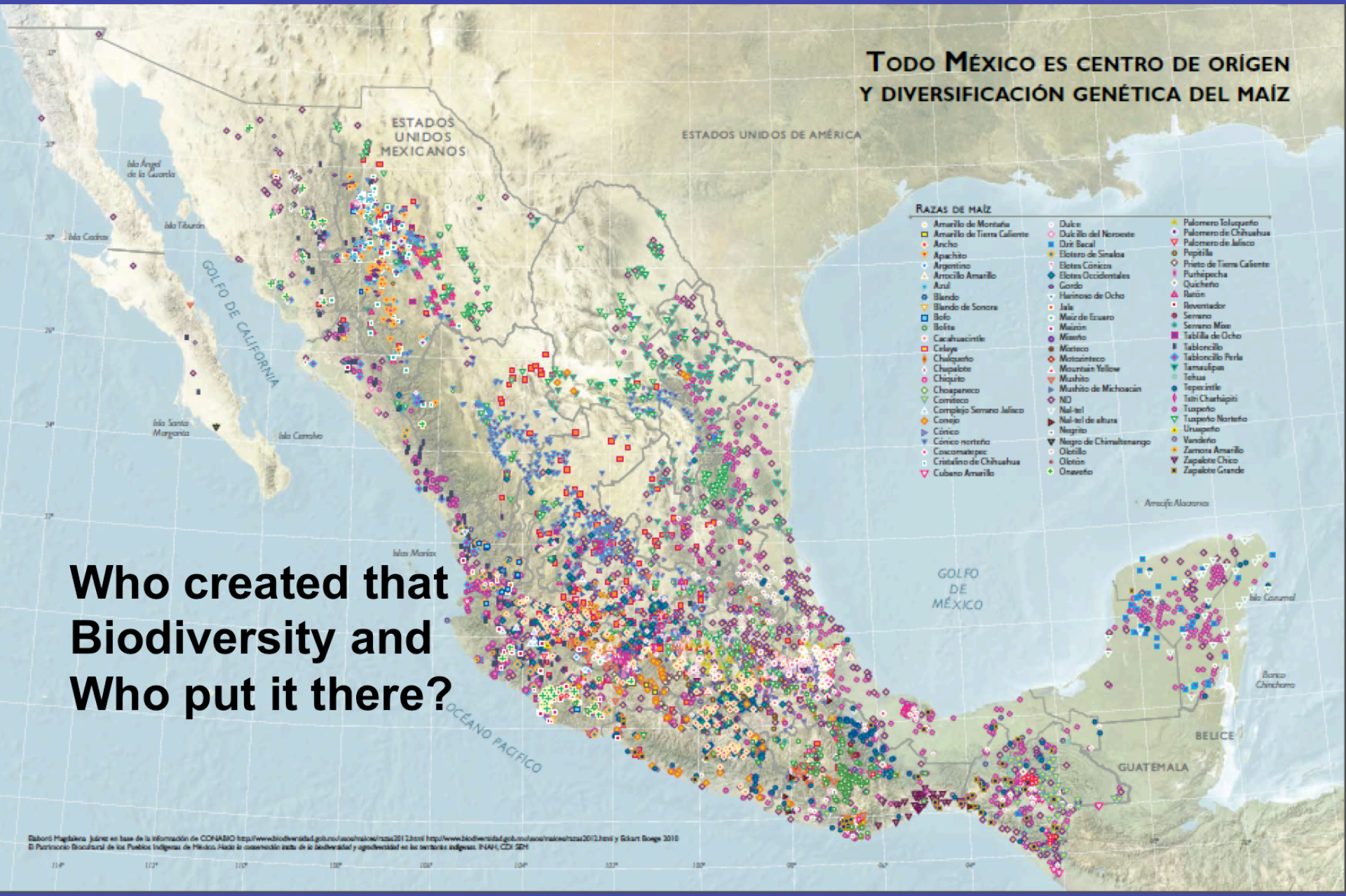
# “The Northamerican maize agroecosystem”



# Maize as human food




**Who created that Biodiversity and Who put it there?**

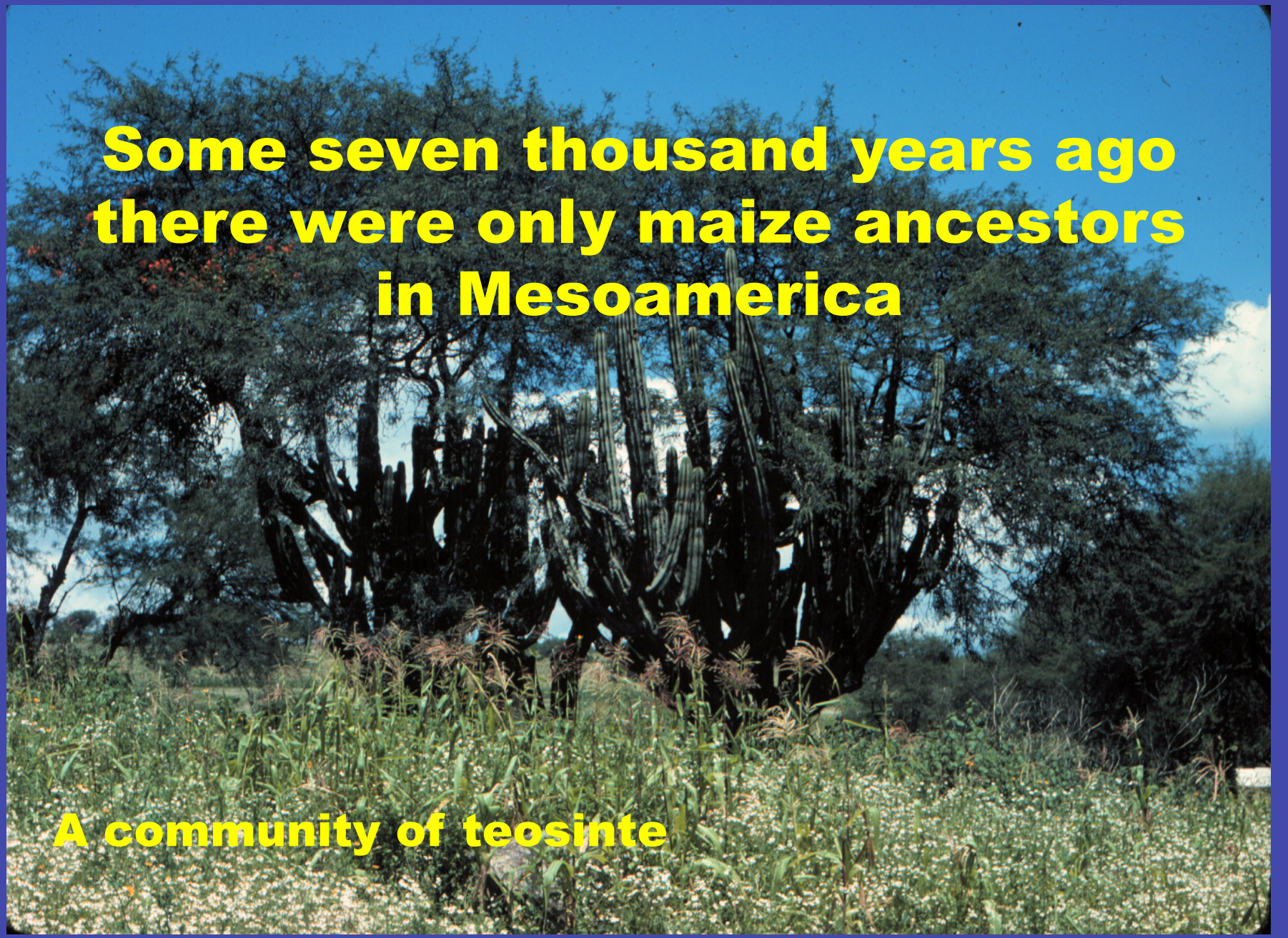

Some seven thousand years ago there were only maize ancestors in Mesoamerica
A community of teosinte

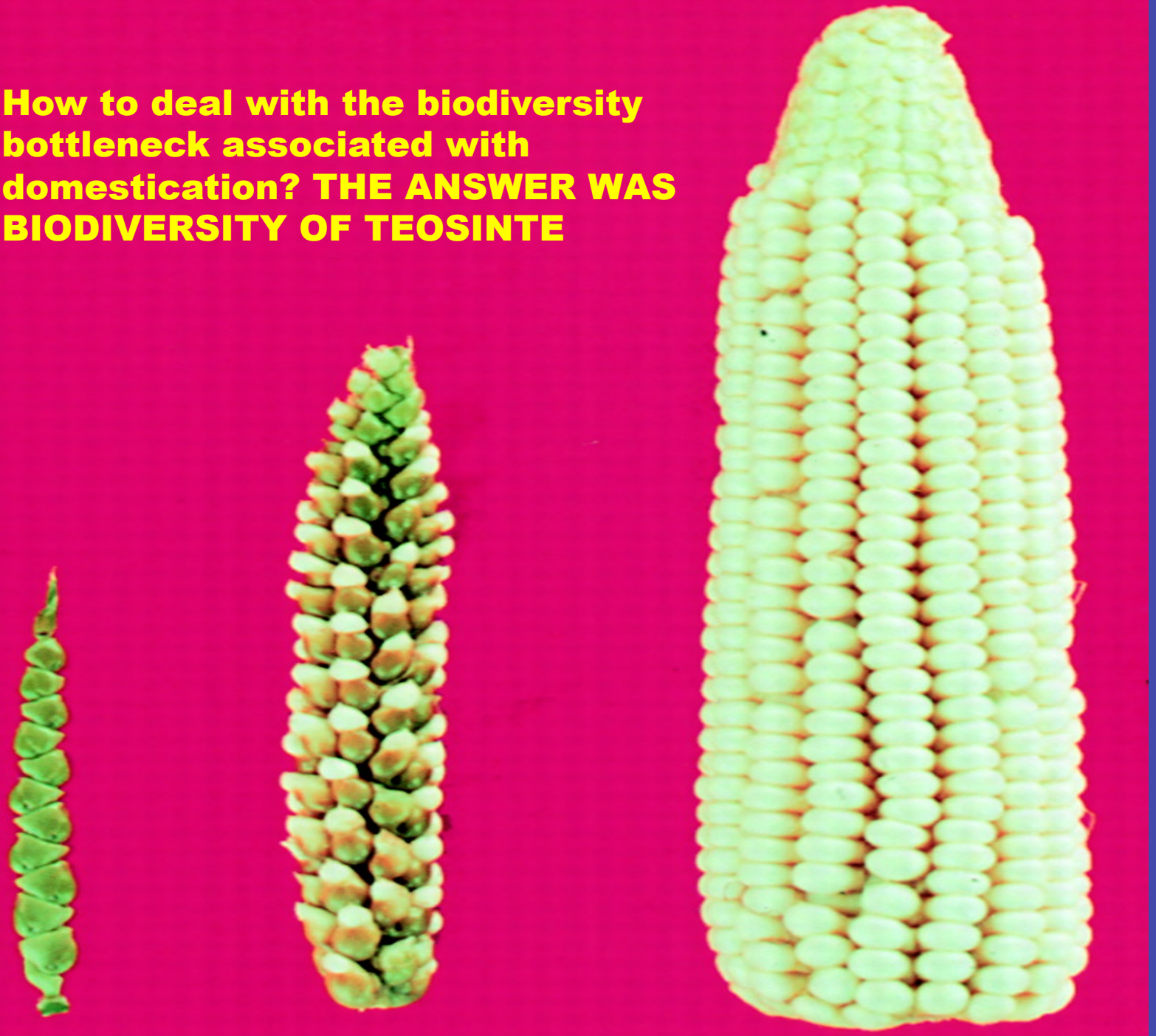

**Figure 1. Teosinte distribution in Mexico.**

# OLDEST EAR RELICS FOUND IN OAXACA

**The Guilá Naquitz ear relics have non disarticulating rachis, spikelets perpendicular to rachis and exposed kernels: dated 6250 years ago**

**More advanced ears dated 700 years later were found in the San Marcos caves, now with two spikelets per knot.**

**How to deal with the biodiversity bottleneck associated with domestication? THE ANSWER WAS BIODIVERSITY OF TEOSINTE**



# Autochthonous maize breeding

The central elements of this procedure as described by Hernandez X. are:

1. Selection of ears and seeds by women as the steering mechanism for breeding in accordance with cultural consensus on the ideal type of ear and seed for each use.
2. Seed interchange and circulation of genetic materials among local plots, sampling ecological niches and year to year variation of biotic and abiotic stresses.
3. Frequent introduction of new genetic (allopatric) materials by ethnic farmers and hybridization with local seed.
4. Parallel, multilocation repetition of this process for prolonged periods of time.
5. Entire Mexican maize agroecosystem used as the critical operating genomic space.

By the time of encounter of the two worlds, modern maize had been developed already; AMB had been going on for over 4000 years.

# Frequent traits of some native races of maize in Mexico

- High quality of kernel protein.
- High kernel oil content.
- Resistance to some field pests and diseases.
- Resistance to some pests and diseases in the granary.
- Adaptation to soil extreme acidity.
- Adaptation to soil high alcalinity.
- Associative relations for biological Nitrogen fixation, resistance to root diseases, etc.
- Biological control of pests.

**Adventitious roots of Oloton maize race.**
**Sierra Mazateca of Oaxaca.**
**Mucilaginous material**

**Plants with outstanding vigor**

# Multipurpose associative relations of maize

**More than 50% frequency of this character in the Olotón maize race of the Mazateca Sierra in Oaxaca**

**A MS thesis under Dr. Ronald Ferrera of the Postgraduate College**

- **Thirty six out of 46 mucigel isolates showed N fixing capacity. The genera involved were Pseudomonas, Azospirillum, Derxia, and Xanthobacter;**
- **Six mucigel isolates and three soil rhizosphere isolates showed antibiotic activity against genera Rhizoctonia, Sclerotium and Fusarium;**
- **Three out of 96 mucigel and rhizospheric soil isolates showed simultaneous activity in biological N fixation, antibiosis and dissolution of soil P. The genera involved were Azospirillum, Citrobacter and Enterobacter.**

# BIOLOGICAL PEST CONTROL, A CLEAN TECHNOLOGY

## "Maize's bud worm as an example"

## (Dr. Fernando Bahena INIFAP-Uruapan)

- **The Mexican arsenal of parasitoids of bud worm (*Spodoptera frugiperda* J.E. Smith) includes 40 species that coevolved with maize and bud worm. Twenty-five species of those parasitoids were found to control 60 % of infested plants in 85 fields of Michoacán in 2008.**

- **There are also bud worm pathogens, plant extracts and other environmentally friendly means for controlling this pest.**

- **Public investment to develop and apply this native defense arsenal would make economic and ecological sense.**

# NIXTAMALIZING PROCESS
# (Alcaline cooking)
# Appeared some 2000 years ago

**COMPARED TO UNTREATED GRAIN:**

- Makes niacin (vitamin B3) available;
- Increases 7.5 times the amount of bioavailable Calcium;
- Decreases content of Phytic acid;
- Eliminates some grain mycotoxins,

**AT PRESENT, DIRECT CONSUMPTION OF NIXTAMALIZED MAIZE GRAIN ACCOUNTS FOR 53% CALORIC INTAKE AND 39% OF PROTEIN INTAKE IN THE NATIONAL DIET.**

# MAIZE IS USED IN 600 DIFFERENT DISHES, BEVERAGES AND TAMALES. MOST FOOD PREPARATIONS REQUIRE SPECIFIC LANDRACES


Tacos





Photos taken from internet. Public domain

**The mega-diversity of the Mexican maize agroecosystem would not be adequately served by a short number of non transgenic or transgenic hybrids that would satisfy for Mexico jointly: a) food security, b) the pluricultural uses of maize as food, and c) a clean ecology.**

**It is common place that inter and intra-racial genetic diversity of maize land races is central to those objectives as well as for mankind.**

**Maize landraces are unchallenged in marginal agro-niches: drought, frost, high elevation, short season, and sierras.**

# Putative differences between two maize breeding strategies

| Criteria | Autochthonous (Hernández X.) | Modern (Mendelian plus GMO) |
|---|---|---|
| Adaptation | To all agro-niches | To selected agro-niches |
| Biodiversity | Is a Strategic tool | Substituted by uniformity |
| Objective | Grain yield + organoleptic and nutritious properties of grain | Grain yield |
| Arena | All ethnic/mestizo farming units, 5000 years, parallel processing, open-cross-pollination | Professional, 100 years, scientific method, controlled hybridization |
| Access | Free seed interchange and self-production | Private property (royalties) |
| Resilience | Highly probable | Improbable |

**Can this splendid pre-Columbian system be helped rather than imperiled by modern science or by modern technology?**

**Who stands to gain and who stands to lose?**

**Do we know enough about possible outcomes of:**

1. **Infiltrating TG-DNA into AMB genomic space?**

2. **Allowing TG-DNA to accumulate at best as junk debris and at worst as a threat to native maize survival?**

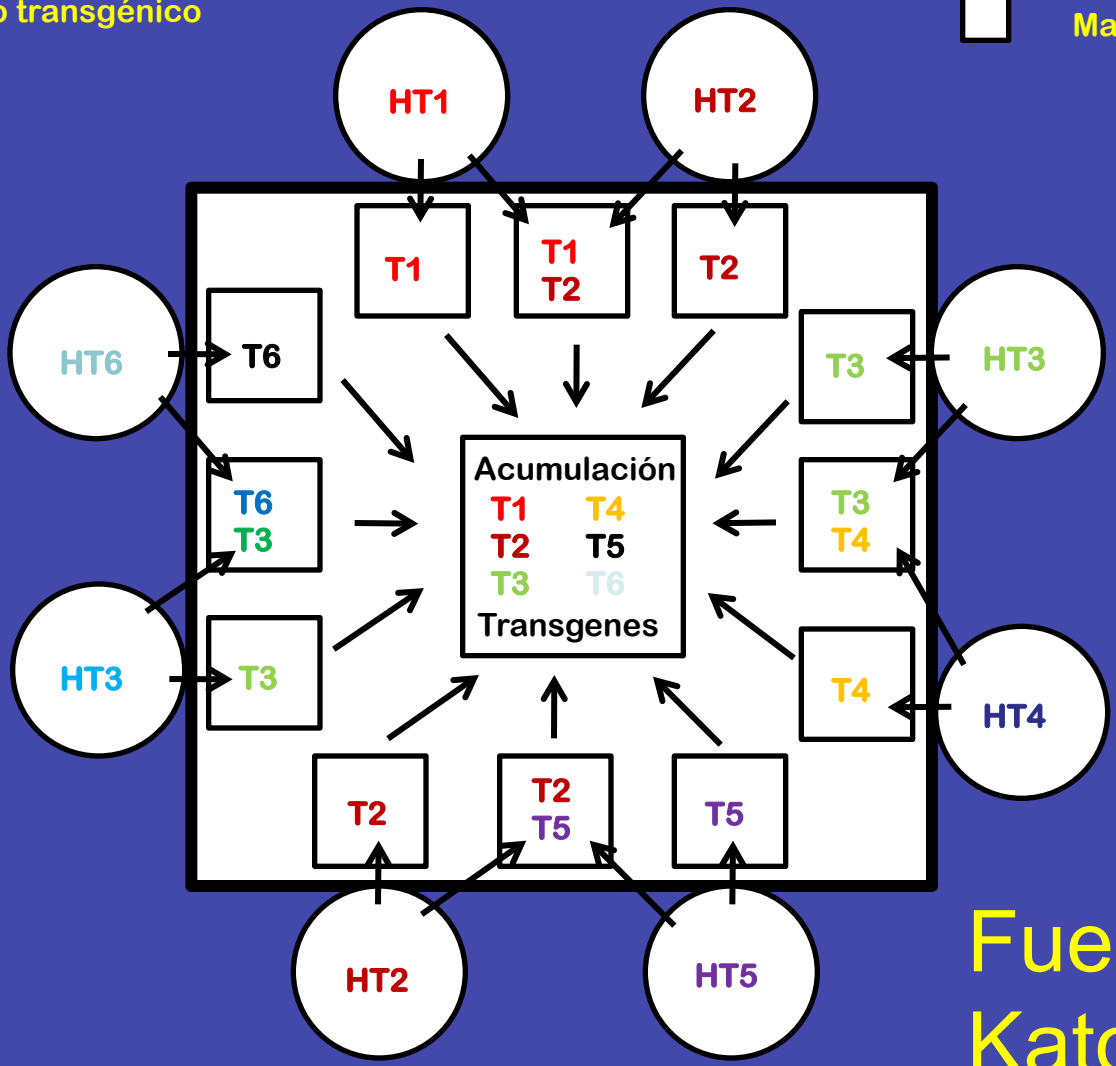
# PROCESO DE CONTAMINACIÓN DEL MAÍZ NATIVO POR DIVERSOS TRANSGENES

T Transgen

HT Híbrido transgénico

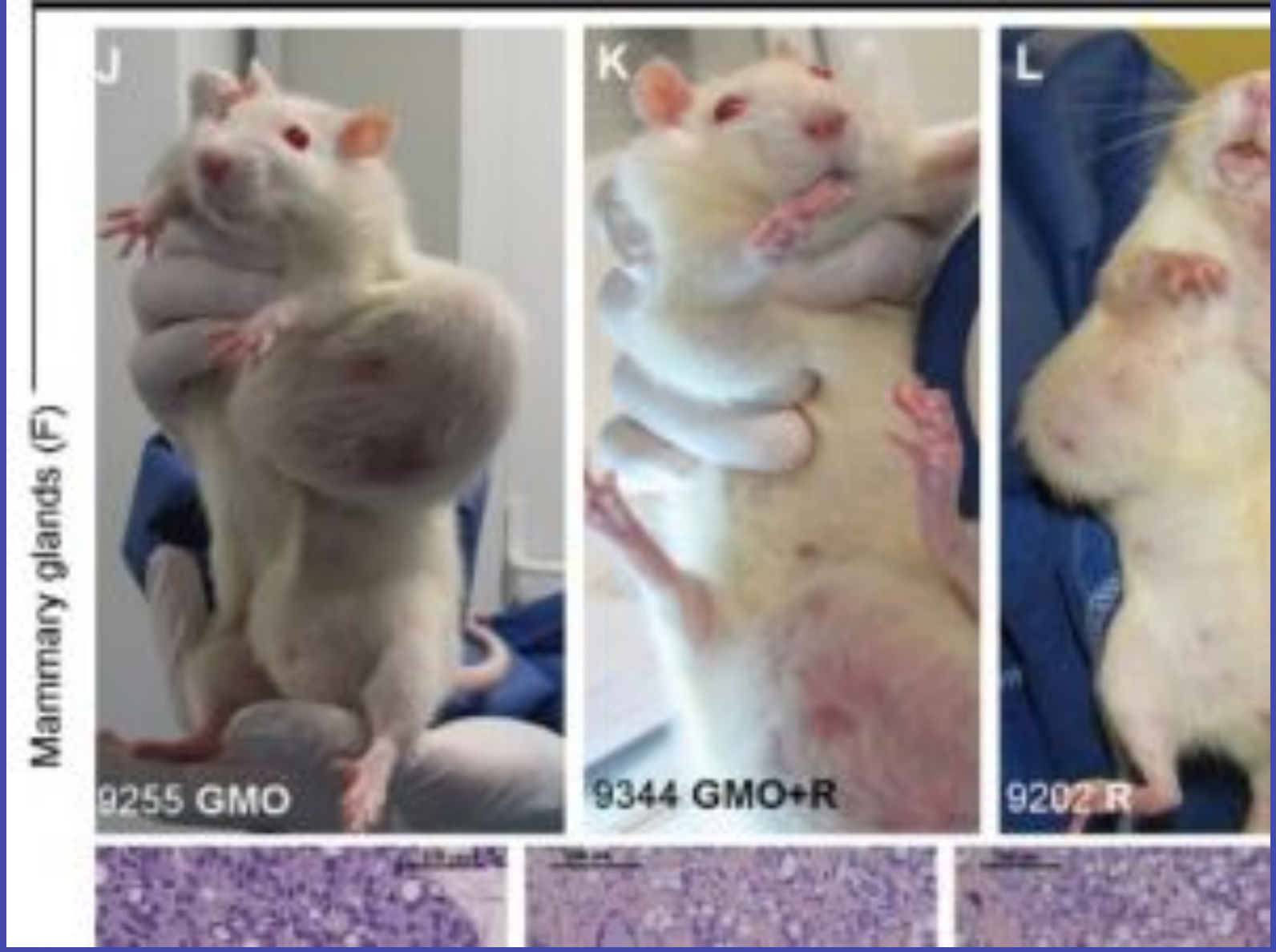
Híbrido transgénico

Maíz nativo




**A esto habrá que considerar el aumento numérico de cada uno de los diferentes trangenes y desarrollados de *de novo* con el paso del tiempo.**

Fuente:
Kato 2014

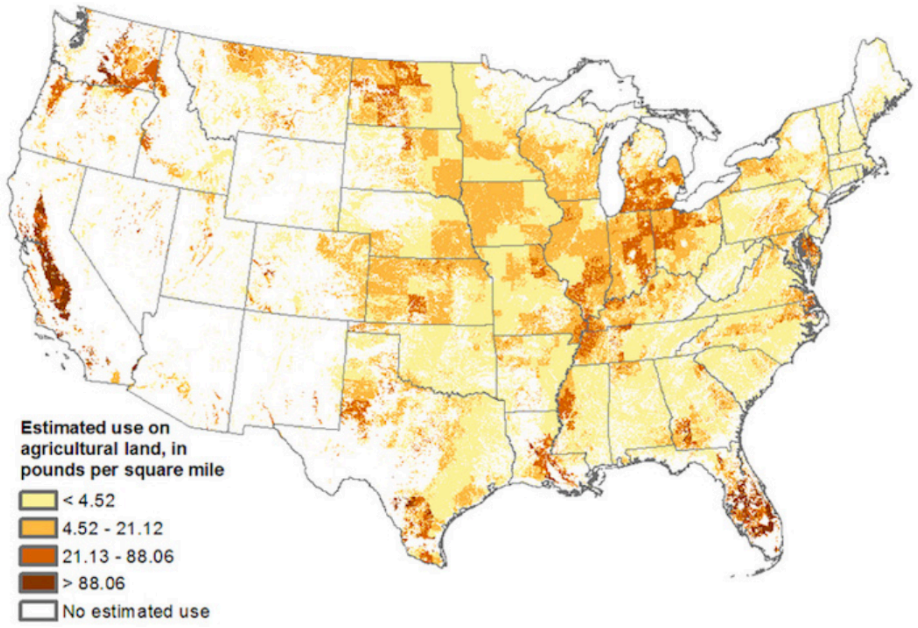



FUENTE: Seràlini *et al.* 2012. Food and Chemical Toxicology. 50:4221-4231

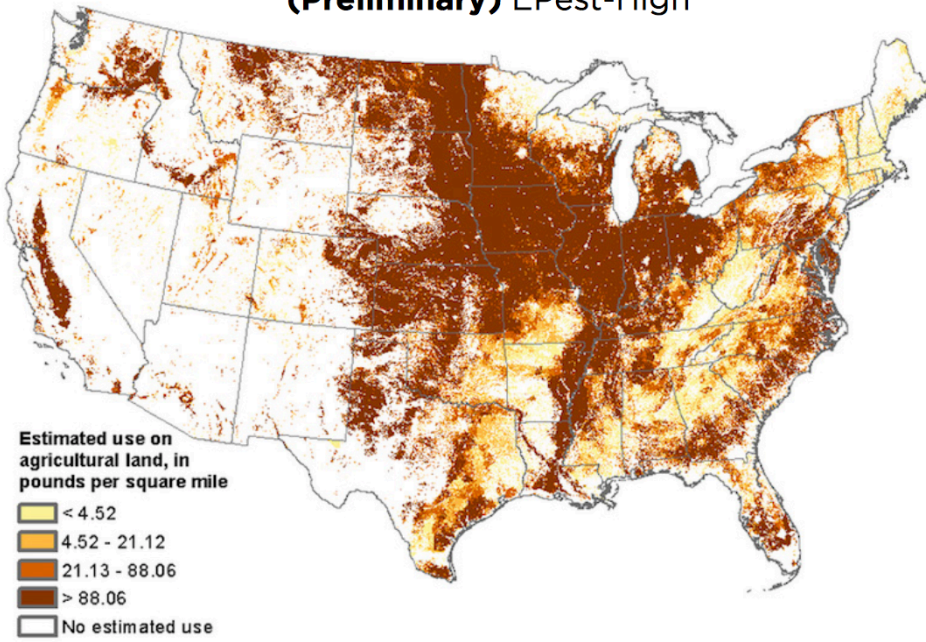
**EVENTO TRANSGÉNICO NK 603**

# EVOLUCIÓN DEL USO DE GLIFOSATO EN EEUU

**Estimated Agricultural Use for Glyphosate, 1992**
EPest-Low




**Estimated Agricultural Use for Glyphosate, 2014**
**(Preliminary)** EPest-High



# El riesgo pertinente para México es el que asumirá en la etapa avanzada de la transgenización de la producción de maíz

**Características probables de la etapa de transgenización avanzada:**

- Oligopolio total del mercado de semilla de maíz, ya toda OGM.
- La diversidad genética intraespecífica sustituida por uniformidad genética.
- Marco legal proclive a la industria multinacional de semillas transgénicas (IMST).
- Cualquier semilla que contenga ADN transgénico es propiedad intelectual de la IMST.
- Queda proscrito el intercambio de semillas, su venta y cruzamiento.
- Es ilegal la autoproducción de semilla.
- La administración genética de la semilla en manos de la industria.
- El Estado paga subsidio a la IMST por el uso de sus maíces nativos transgenizados.
- El grano transgénico sustituye al grano normal en la alimentación humana, como forraje y como insumo industrial.
- El etiquetado de alimentos de origen transgénico no es obligatorio.
- La industria no es responsable de cualquier daño a la sociedad (salud humana y/o a la ecología), a menos de que la causa-efecto sea demostrada científicamente.

# A COLLECTIVE DEMAND BY MEXICAN CITIZENS

Fifty-three Mexican citizens and twenty farmer and consumer organizations initiated legal proceedings against the Mexican government and five multinational seed companies three years ago.

The charge is that the human right of Mexicans to use native maize biodiversity as they see fit is threatened by the introduction of transgenic maize. This is a human right of this and future generations.

The plaintiffs demanded as a precautionary measure that as the trial proceeded, no further permits for planting transgenic maize should be granted. This precautionary measure was granted three years ago and it still is in effect at present.

# CONCLUSIONS

1. Mexico needs from its precolumbian technologies: maize landraces for food security and pluricultural uses of maize as food, and biological pest control for a clean ecology.

2. In the last 50 years, maize landraces have coexisted with modern maize (hybrids) using it as an allopatric source of germplasm; after all, genomes are the same.

3. Should transgenic maize become the source of allopatric germplasm, transgenes would irreversibly accumulate in maize landraces, with effects yet to be known.