

***The Spanish experience with co-existence  
after eight years of cultivation of GM maize***



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**Co-existence of genetically modified, conventional  
and organic crops. FREEDOM OF CHOICE**

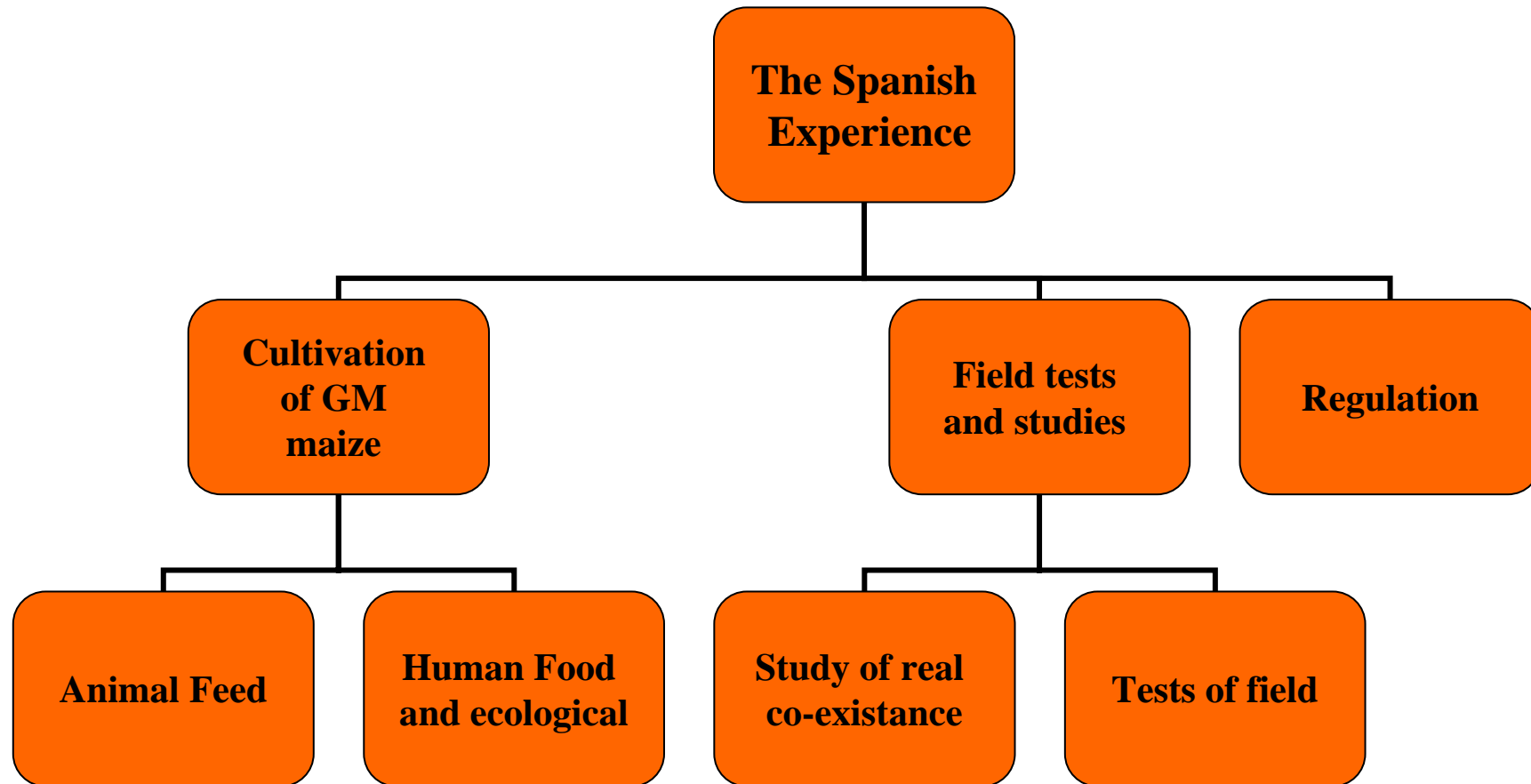
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# Introduction



- ⌘ The co-existence is defined as the ability of farmers to be able to choose the type of cultivation of a certain species: genetically modified, conventional or organic. None of them can be excluded.
- ⌘ The Traceability and Labelling regulation for food and feed that is in force requires that any food and feed containing over 0.9% authorised GMOs be labelled as a GMO.
- ⌘ It is very important to know the economic consequences that can to produce the accidental presence of OGM in a maize crops that is not it.
- ⌘ The good practices required for both GM and non-GM maize cultivation must therefore be known so that they comply with the above regulations.
- ⌘ In these last years diverse Spanish institutions have been made field test to evaluate the possible coexistence between the conventional and the transgenic maize, as well as studies of the existing real coexistence in the cultivation of maize.
- ⌘ Currently there is a "Real Decree" draft on the coexistence of conventional, organic and genetically modified crops. It is predicted that comes into force for the cultivation of maize in 2007.

# THE SPANISH EXPERIENCE

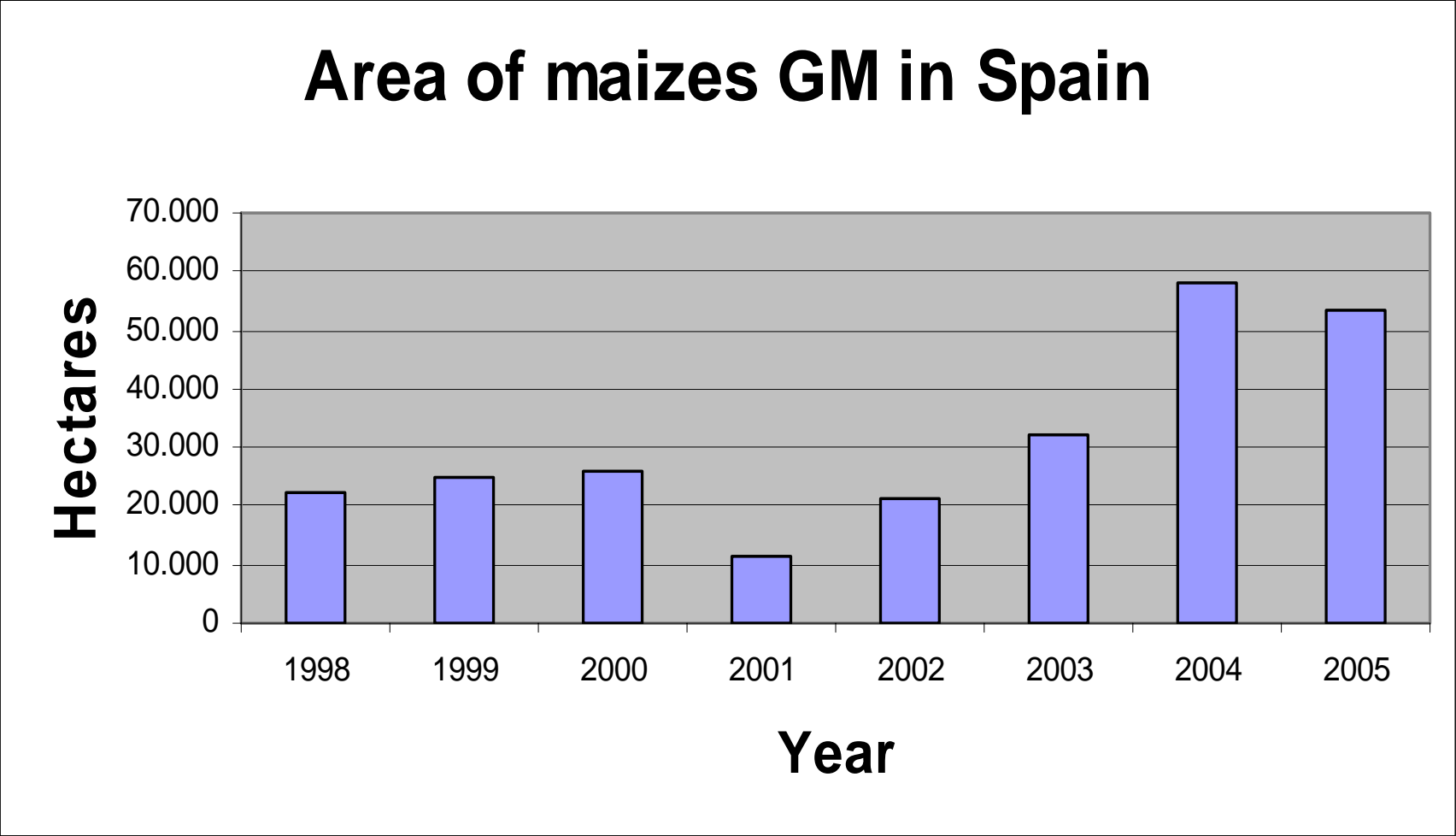


# GM maize crop in Spain



- ⌘ 1998: 2 first varieties maize genetically modified in the Spanish list.
- ⌘ 2006: 25 varieties genetically modified maize that contain the event MON 810 resistant to the plagues of *Sesamia nonagroides* and *Ostrinia nubilalis*
- ⌘ 1998-2006: 242 varieties of maize has been asked for their inscription.
- ⌘ 2004: 480,000 hectares sowed of grain maize. In addition 85,000 hectares of forager maize.
- ⌘ 2004: 58,200 hectares sowed maize GM.
- ⌘ 2005: 425,000 hectares sowed of grain maize, 53.225 of this hectares they are GM.

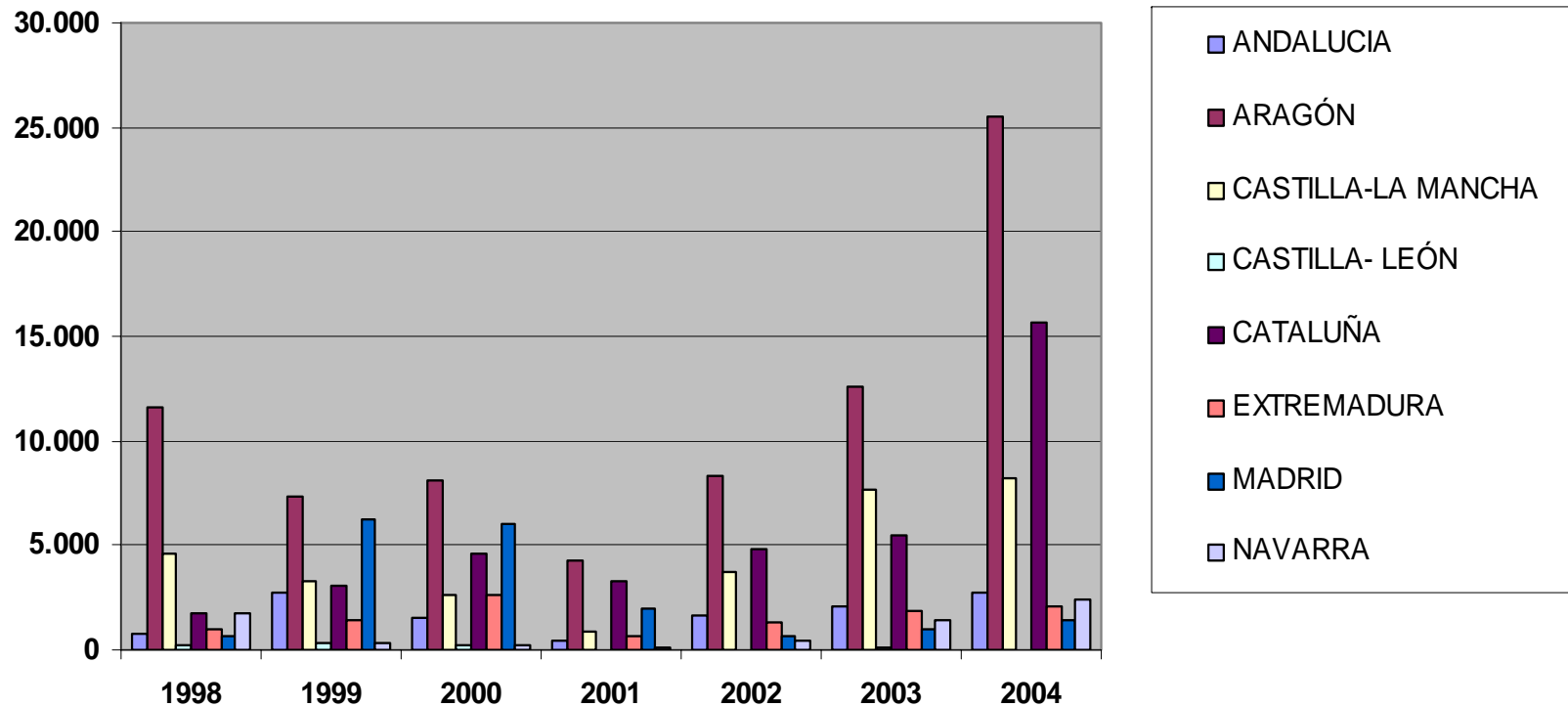
# GM maize crop in Spain



# GM maize crop in Spain



AREA OF MAIZES OGMs IN SPAIN BY AUTONOMOUS REGION (Ha.)



# **% GM maize crop in Spain – 2004 and 2005, by Autonomous regions**

AUTONOMOUS REGIONS	hectares 2004		% OGM	
	GMO	Totals	2004	2005
CATALUÑA	15.699	41.799	37,56	41,7
ARAGÓN	25.547	91.042	28,06	28,9
NAVARRA	2.446	15.343	15,94	21,6
MADRID	1.385	8.801	15,74	2,02
CASTILLA- MANCHA	8.197	54.851	14,94	16,6
VALENCIA	73	746	9,79	31,2
ANDALUCIA	2.770	48.216	5,74	7,0
MURCIA	12	230	5,22	0
EXTREMADURA	2.026	58.450	3,47	2,1
BALEARES	29	874	3,32	0
LA RIOJA	35	1.642	2,13	2,6
CASTILLA- LEÓN	0	131.211	0	0
GALICIA	0	24.702	0	0
ASTURIAS	0	1.000	0	0
CANARIAS	0	480	0	0
PAIS VASCO	0	173	0	0
CANTABRIA	0	125	0	0
<b>TOTAL</b>	<b>58.219</b>	<b>479.685</b>	<b>12,14</b>	<b>12,5</b>

# Tests to determine the effect produced by *Sesamia* and *Ostrinia* in maize crop

⌘ Comparison between the production of the varieties GM maize with respect to its respective isogenics varieties. Average 5 trials. Spain 2005

<u>Varieties</u>	<u>Production</u>	<u>Rate</u>	<u>Test Tukey (<math>\alpha=0,05</math>)</u>
	(kg/ha 14 %)	(%)	
GM	14.268	104,5	A
No GM	13.045	95,5	B

Average 5 trials (kg/ha): 13.656 kg/ha to 14% humidity  
significance p-validity < 0,0001

# GM maize crop in Spain



- ⌘ The annual production of maize in Spain is about 4.5 million tons.
- ⌘ In July 2004/ July 2005, has been necessary to import 4.1 million tons, from France (more of 50 %) and Argentina.
- ⌘ The national production of animal feed amounts in 2005 to more than 20 million tons, with around 20% of soybean in its composition. The 98.7 % of this soybean is genetically modified, by which practically the totality of the feed is labelled like GMO.
- ⌘ Although a specific regulation for the coexistence in Spain has not existed during these years of cultivation of transgenic varieties, the seeds producers have made recommendations for cultivation of maize, with special insistence in the accomplishment of refuge area.
- ⌘ The maize buyers for animal feed, mix the different maize harvests, conventional or GMO, and they pay the same price for them, so the totality of the farmers has obtained the same price regardless of the type of crop.

# GM maize crop in Spain



- ⌘ In the maize production for human consumption, and due to the greater price of the maize destined to human consumption among other reasons, it is not desired to label like transgenic. So commercially companies usually contract the crop of some plots, provide the seed and control the absence of GM crops, in the proximity of these plots.
- ⌘ In the maize production for industrial consumption (starch and glucose), all the farmers of a determined region have agreed themselves not to grow GM varieties, with views to the marketing to the starch obtaining non-GMO.
- ⌘ In the case of the organic crops, it is in where the pressure of the farmers who grow these organic crops and associations is greater.

# Field tests and Co-existence studies



- ⌘ **The most important sources of accidental presence of GMO in the maize crop are the following ones:**
  - ⌘ impurity of the seed,
  - ⌘ machinery of sowing and harvests,
  - ⌘ rest of the previous crop,
  - ⌘ transference of pollen between neighbouring plots and
  - ⌘ storage of the harvests.
  
- ⌘ **The sum of all the causes of accidental presence of GMO, cannot exceed the threshold of 0.9 %**

# Field tests and Co-existence studies



- ⌘ In first place, and whatever to the purity of the seed used by the farmers, it would emphasize the control that is made in Spain in the conventional maize seed (1000 lots more analyzed the last campaign), to determine if they contain GMO.
- ⌘ The first thing for a good coexistence, is to regulate the maximum content of GMO in seeds by the EC, already that is the first source of accidental presence of GMO in the harvests. In maize, this maximum it would not have to be greater than 0.5 %.

# Field tests and Co-existence studies

- ⌘ The Spanish Plant Varieties Office of the Ministry of Agriculture, Fisheries and Food, in cooperation with various official and private institutions, programmed a series of field test and Co-existence studies in the 2003, 2004 and 2005 campaign on varieties of genetically modified maize, aimed at learning of the possible presence of **GMO material in the harvesting of neighbouring non-GMO variety maize, solely due to cross pollination** and not to other possible causes of the adventitious presence of GMOs (seeders, harvesters, seed quality, storage, etc.):
  - ⌘ *The co-existence of different varieties of GMO and conventional maize was simulated,*
  - ⌘ *Under the most extreme conditions,*
  - ⌘ *On different sizes of land and*
  - ⌘ *With different distances between the crops.*

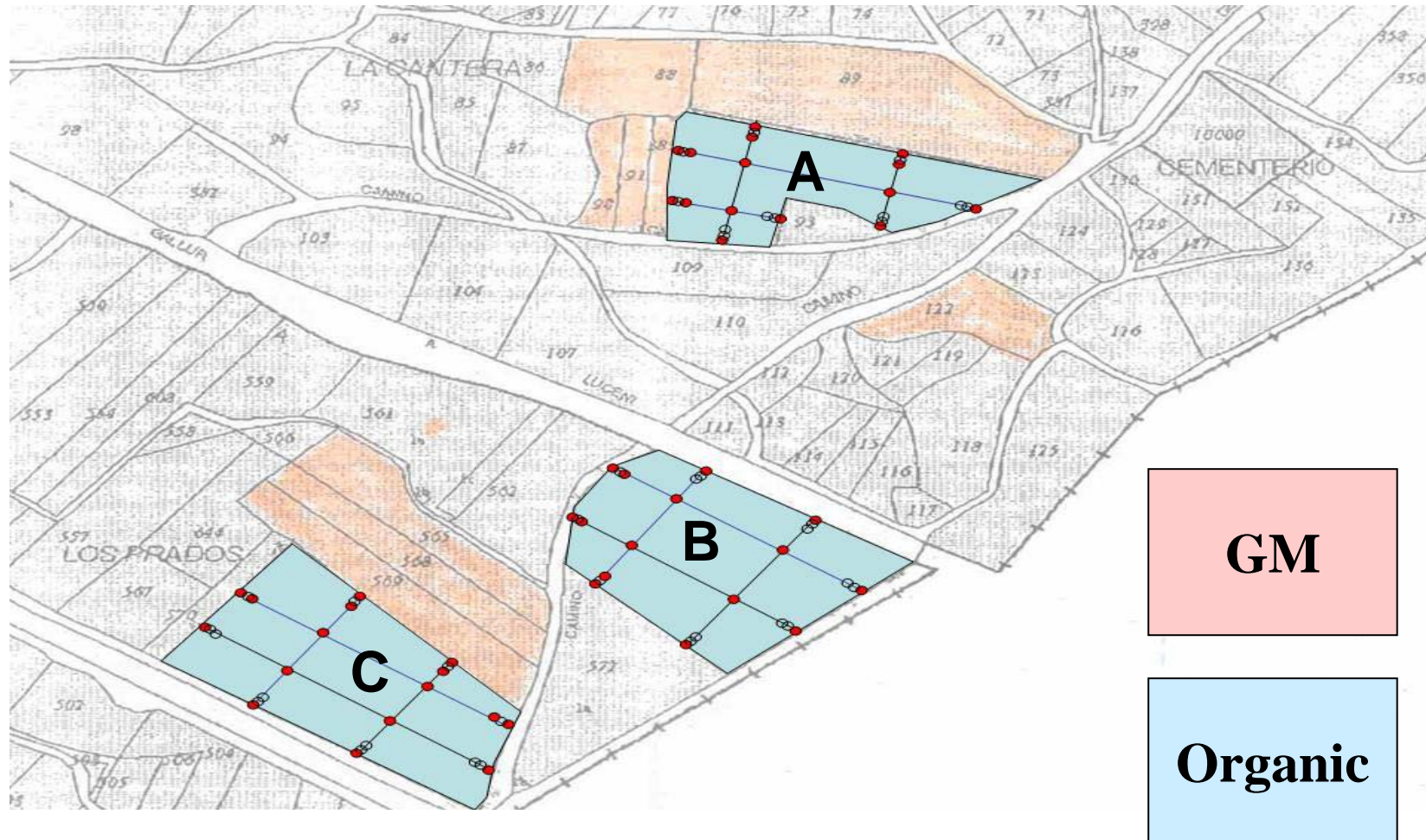
# Study of real co-existence 2004

- ⌘ **Coexistence between GM crops and non GM crops for human consumption:**
- ⌘ Study made in 2004, in an autonomous Spanish region (Extremadura) with 6 % of GM maize crop.
- ⌘ In addition a control was being made in field to verify that the necessary measures for a good coexistence of the crops were adopted, like to verify that the neighbouring parcels were not GM, that was made a good cleaning of the sowing machinery and harvesting, etc
- ⌘ 192 samples was taken on grain deliveries non Gm for human consumption.
- ⌘ 8 of them contained GM, but inferior to 0.9 %.
- ⌘ The average of the 192 samples was of 0.015 % of GM.

# Real Coexistence between GM and organic maize in Aragon (Spain) 2005

- ⌘ In this year 2005 a study is being made to know the real coexistence in the plots of organic maize production in zones of high percentage of maize GM.
- ⌘ They visited most of the plots of the relation of organic maize provided for the community of Aragon, and it was verified that only there were 13 plots that were seeded of conventional varieties and had in their proximities some maize plot GM.
- ⌘ Of these plots only 6 could have problems, so there other maize plots GMO in its proximities, all of them cultivated by the same organic maize farmers, chose the 4 plots, that could have more problems of transference of pollen, to have a maize GM closest, not to exist natural barriers, not to have seeded no buffer zone, greater coincidence in seedtime of the varieties, etc.
- ⌘ The 4 plots in different points have been sampling and the obtained results are that the considered contents of the 4 plots were below of 0.9 %. (0,3 of OGM in the plot A; 0,05 in the B; 0,075 in the C).

# Real Coexistence between GM and organic maize in Aragon (Spain) 2005



# Tests of field made in Spain



**3 tests of field were programmed during the 2003 campaign in Spain.**

**The characteristics of this trials have been the following:**

The sowing, in different localities, of a plot of land with the seeds of a variety of GMO maize containing genes resistant to lepidoptera, together with another sown with a conventional variety (with the same cycle). During the study, samples were taken from the non-transgenic field at different distances from the separating row for real-time analysis using PCR techniques of their GMO content produced by cross pollination with the transgenic maize. Two different works:

- ⌘ Spanish Plant Varieties Office (2 test).
- ⌘ Agro-food Research and Technology Institute (IRTA), SIGMEA project

# Cooperating bodies

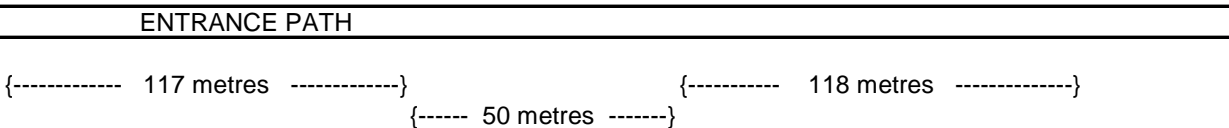
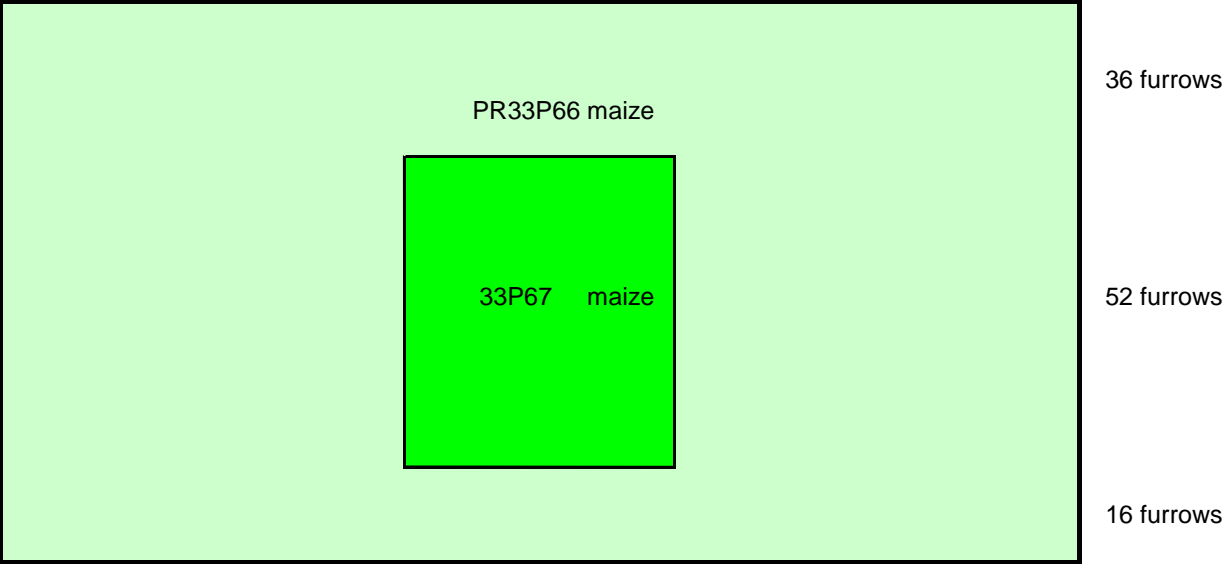
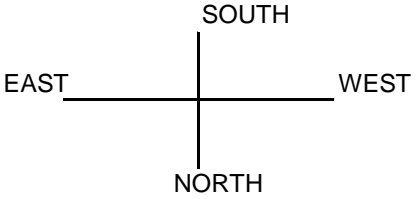
- ☒ The following institutes or companies took part in the undertaking of these tests of the **Spanish Plant Varieties Office** of the Ministry of Agriculture, Fisheries and Food, in sample taking and in the necessary analyses to determine GMO content in those samples:
- ☒ The **Molecular Biology Institute** of the C.S.I.C.
- ☒ The **Agro-food Research and Technology National Institute** (I.N.I.A.) of the Ministry of Science and Technology
- ☒ The **Agro-food Provincial Technical Institute** (I.T.A.P.), Albacete.

# Test protocols 2003

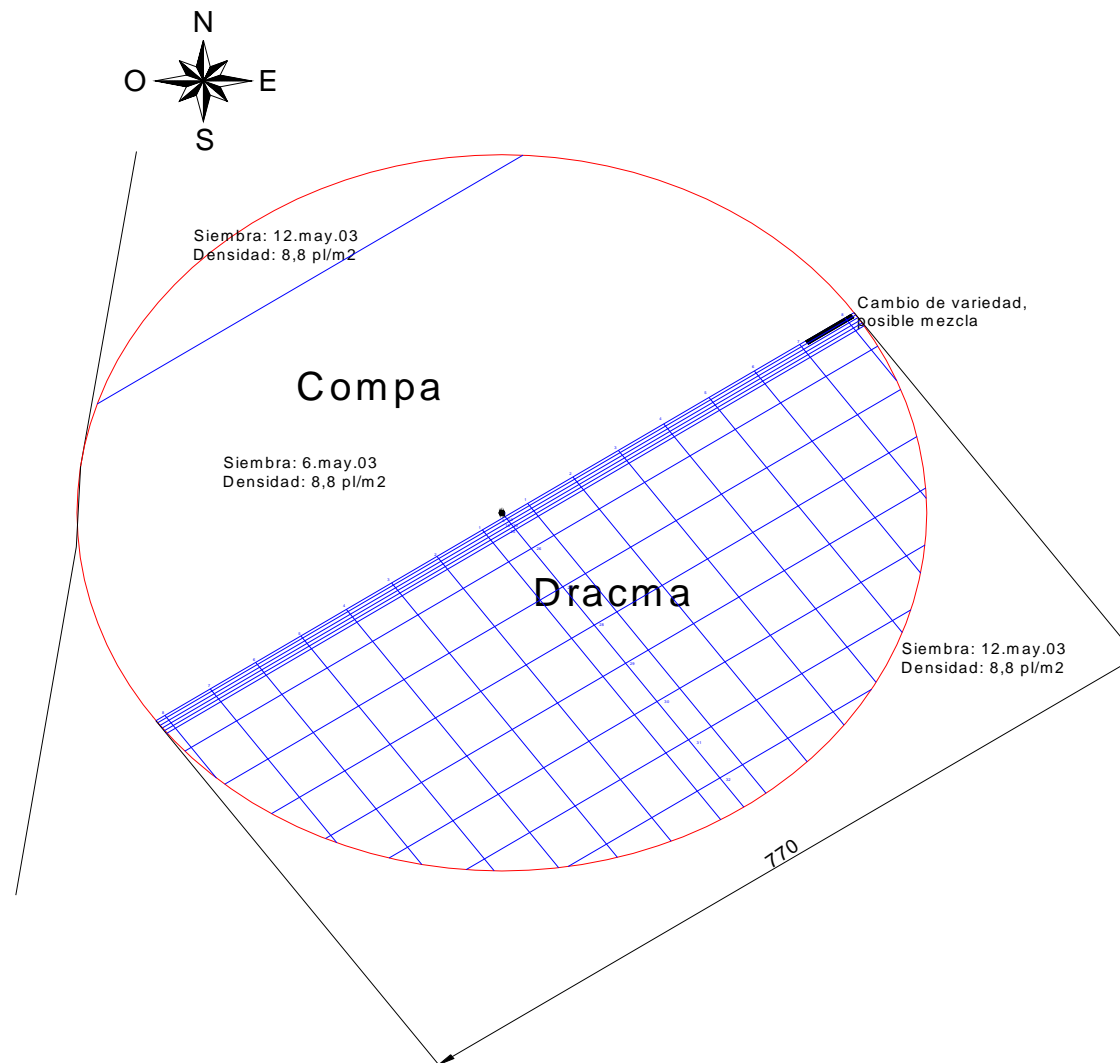
- ⌘ 1.- **Albacete Test**: Half a “pivot” of around 46 Ha. was sown with the Compa CB variety (GMO: Bt176) and then the other half with the Dracma variety (isogenic non GMO). There was a gap of 6 days between both sowing dates due to the rainfall after the first, although there was an extensive coincidence in the flowering period of both varieties.
- ⌘ 2.- **Colmenar de Oreja Test**: The design of the test sown in Colmenar de Oreja was made up of a rectangle of PR33P66 maize (non GMO) measuring 285 by 75 metres, in the centre of which another approximately 50 by 37 metre rectangle of the PR33P67 variety (GMO: MON810) was sown. The sowing dates of both varieties was almost the same, with only a one-day gap between them.
- ⌘ During all of these tests, different samples were taken from the plots sown with non-transgenic varieties at different distances from the GMO plots, using a very similar protocol in the three tests. These samples were dried, husked, ground and homogenised before a sub-sample was obtained from each one, which was analysed using the quantitative PCR method to determine the percentage of GMOs. The samples from the first two tests were analysed at the IBM laboratories in Barcelona and those from the Lérida test in the Irtagen laboratories. The prevailing wind direction was also analysed on flowering days.

# Colmenar de Oreja (Madrid) test 2003

TEST LAY OUT ON THE "CASA CONCHA" Farm Colmenar de Oreja (Madrid)

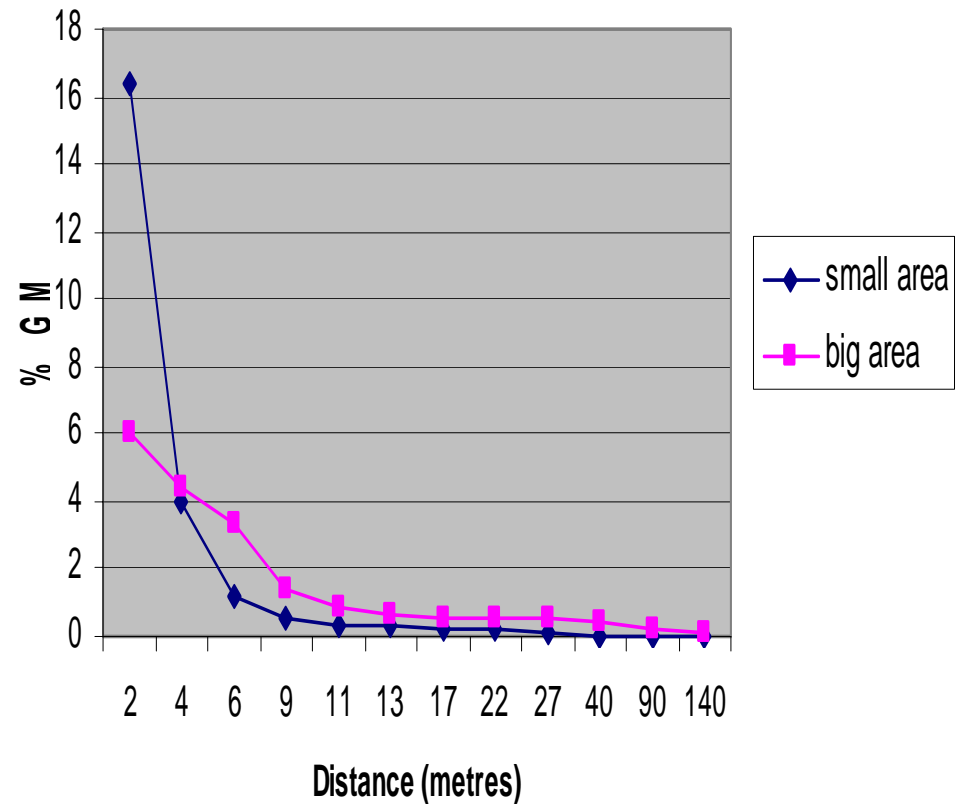


# Albacete test lay out 2003



# Small area compared to big area test results

Distance Metres	% GMO	
	Small area GM	Big area GM
	Madrid	Albacete
2	16,4	6
4	4,01	4,4
6	1,18	3,3
9	0,58	1,43
11	0,375	0,9
13	0,3	0,67
17	0,24	0,55
22	0,17	0,57
27	0,09	0,5
40	0	0,45
90	0	0,2
140	0	0,07

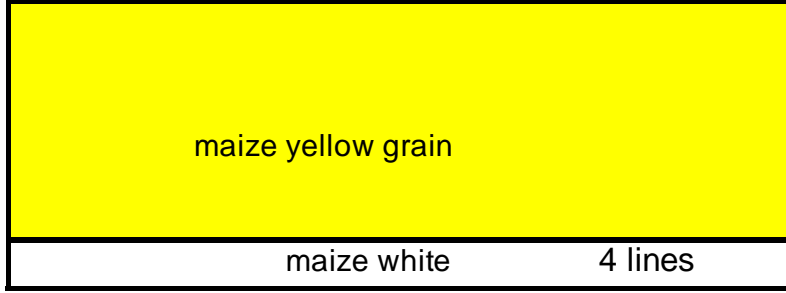


# Test protocol Madrid 2005

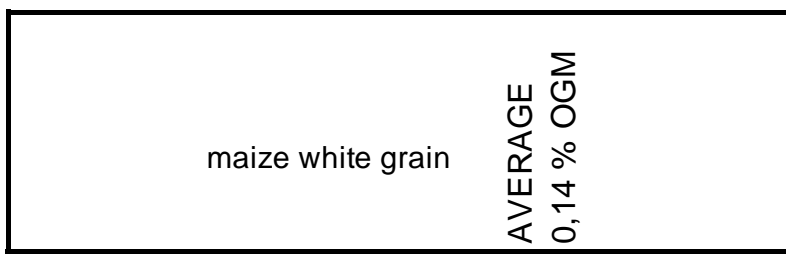


- ⌘ The design of the sowing was formed by white grain alternative maize plots non GM with others of yellow grain GM, with an isolation distance between crops of 50 meters. The yellow maize plots were surrounded by 4 lines of white maize (buffer zone) when they were to 50 meters of the band of white maize. By the effect xenia, the grains of the white grain maize plants fertilized by pollen of the yellow grain maize plants, are yellow color, and half of these grains will be GM. It has been collected one cob each 5 linear meters of crop, and in all the seeded lines of white maize. The total cobs studied have been 2,200, and it has been done establishing the percentage of yellow grains from each cob.
- ⌘ The results obtained in this test have been that, fulfilling the minimum ranges of 50 meters between crops and surrounding the maize GM with 4 lines of maize not GM, the accidental presence of GMO in the maize no GM is below of 0.9 %.

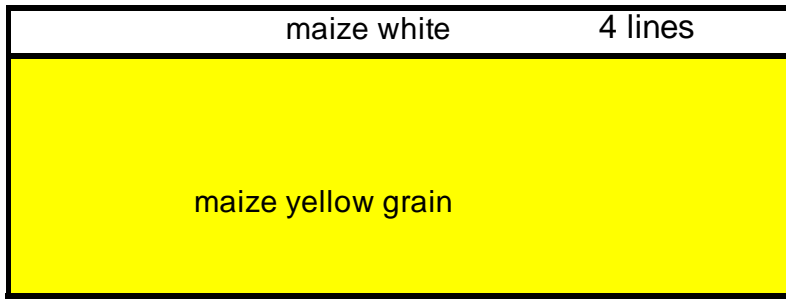
# Aranjuez test lay out 2005



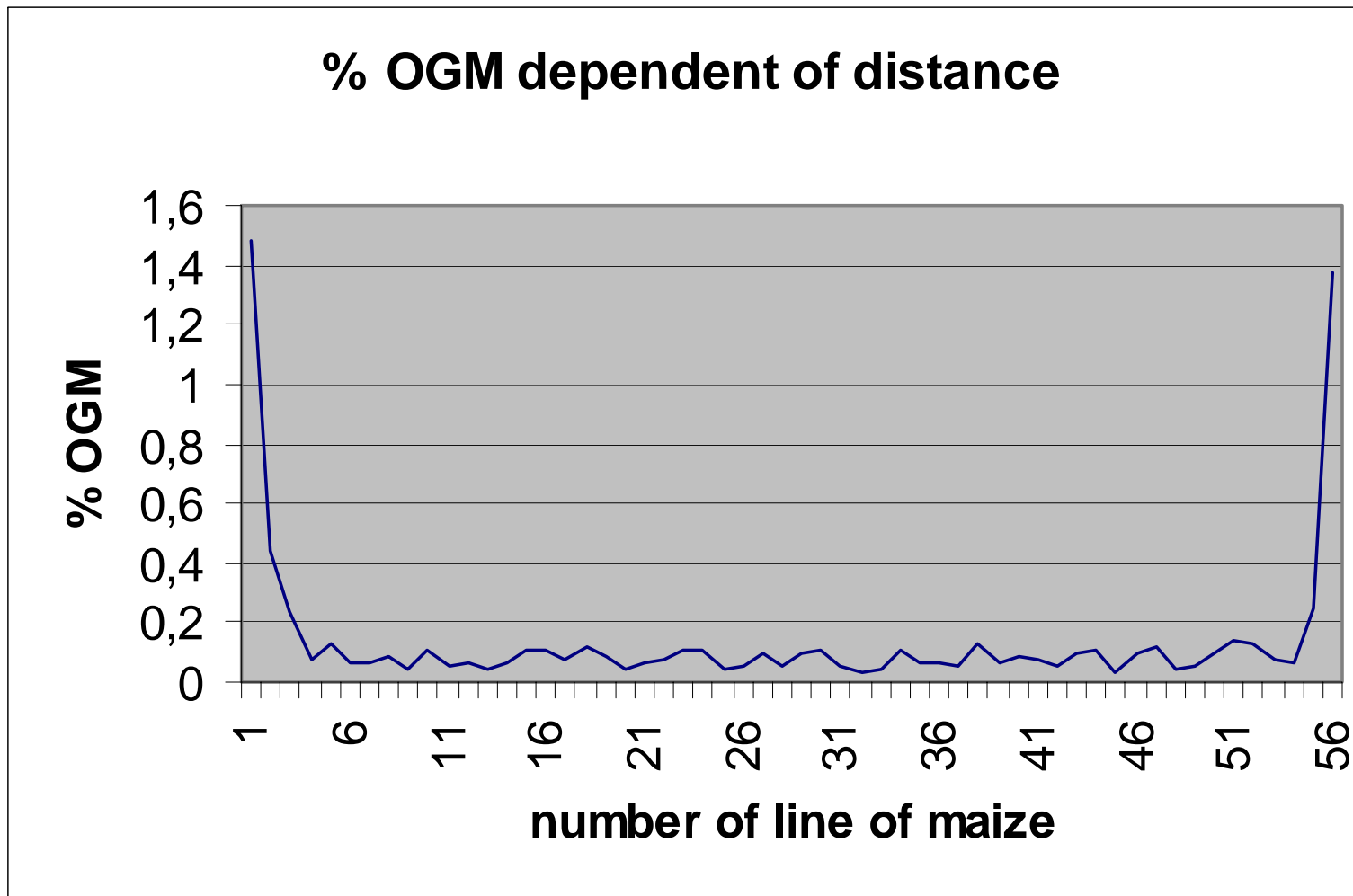
50 metres



50 metres



# Aranjuez test 2005 results



# Summary

- ⌘ According to the studies undertaken, it was seen that the percentage of GMO presence dropped rapidly over the initial metres around the transgenic crop.
- ⌘ Due to the proximity of a genetically modified crop, GMO presence in conventional maize crops depends on:
  - ⌘ *The size of the pollen source.*
  - ⌘ *The size of the non-GMO plot.*
  - ⌘ *The direction of the prevailing wind.*
  - ⌘ *The distance to the pollen source.*
  - ⌘ *The sowing date of both crops.*
  - ⌘ *The existence of natural barrier or buffer zone*
- ⌘ In the tests, when the plots are adjacent, to a distance greater than 15 meters the average content of GMO is below of 0.9 %.
- ⌘ In commercial crops, the transference of pollen is less than to the observed in the tests, due above all to the difference in flowering of the plots.
- ⌘ All these works are not sufficient to tranquilize to the public opinion that stay reticent to accept the coexistence with transgenic crops.