ENHANCING DISEASE RESISTANCE TO FUSARIUM BY USING EXOTIC GENOTYPIC VARIABILITY

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Maize is one of the most important crops worldwide with an annual cultivation area of 150 million ha (FAOSTAT 2007).
According to EUROSTAT, the cropping area within the 27 member states of the EU reached 13 million ha in 2009. Poland is the fifth producing country (679000 ha), after France, Germany, Hungary and Romania with an increasing area.

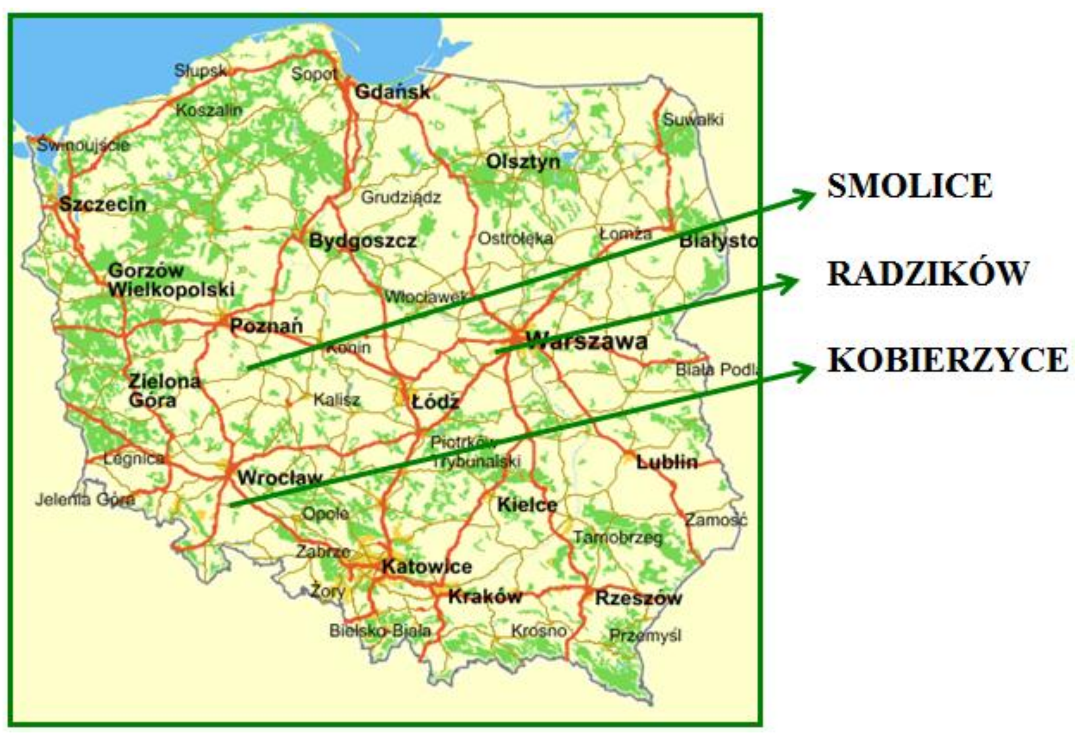
Ear rots caused by *Fusarium* are important diseases in Poland and other world regions affecting yield and causing grain mycotoxin contamination. *Fusarium graminearum* and *F. verticillioides* are two ear rotting species commonly connected with maize kernel samples and their prevalence depends on environmental conditions.

There are several approaches to reduce disease effects, including the use of genetic resistance, which besides of being a technology easily accepted by farmers do not cause environmental undesirable effects. The development resistant host genotypes strongly depends on availability of sources of resistance and adequate selection procedures. Previous studies indicate that Argentinian germplasm is a potential source of resistance to ear rots. Since environmental conditions from maize growing regions from Argentina and Poland are quite variable, host-by-pathogen-by-environment interactions might have lead to the selection of different host genes affecting *Fusarium* reaction, which might be combined by crossing sources of resistance from each country.

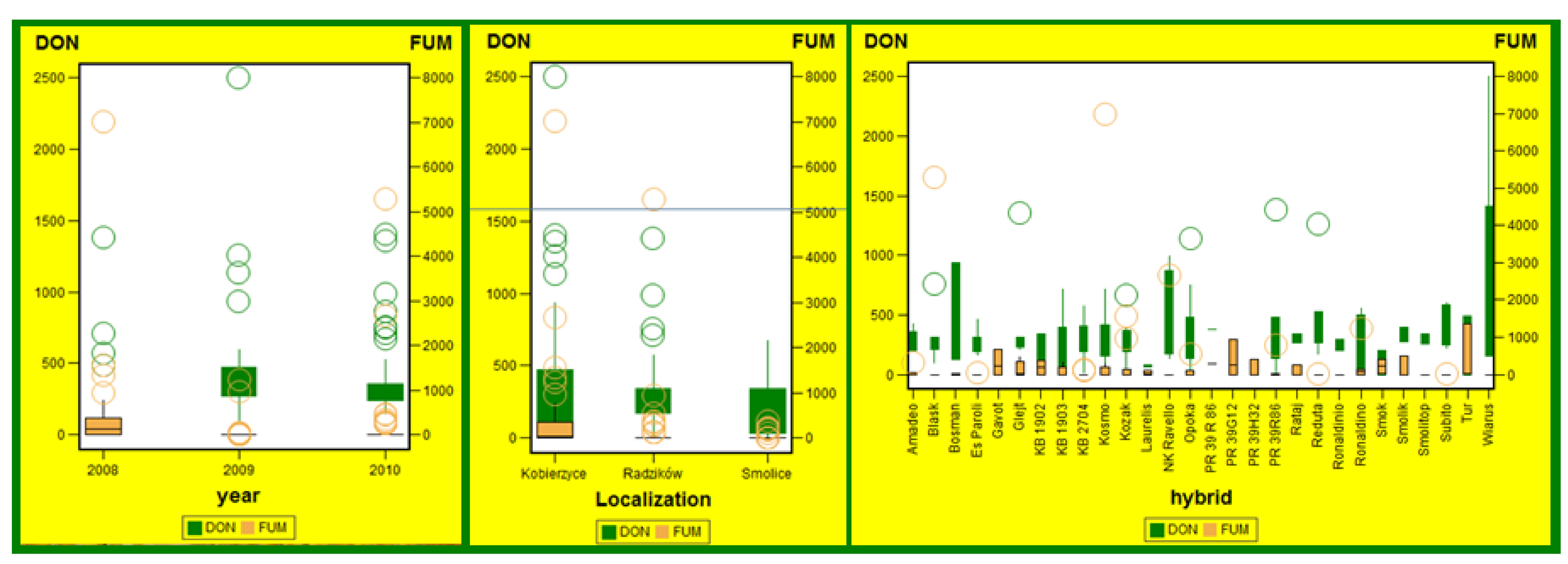
OBJECTIVE

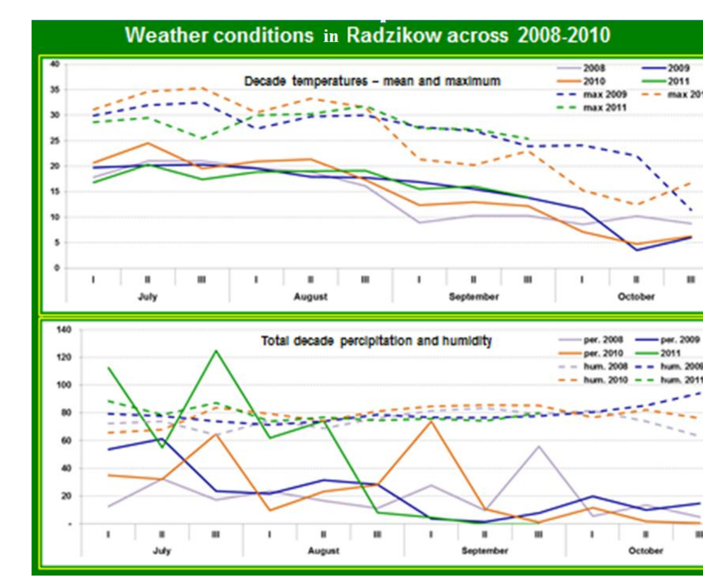
The aim of this study was to identify the best sources of resistance to Fusarium from Polish maize germplasm to develop new breeding populations based on crosses with sources of resistance introduced from Argentina

EAR ROT SEVERITY, GRAIN MYCOTOXIN CONCENTRATION IN POLAND



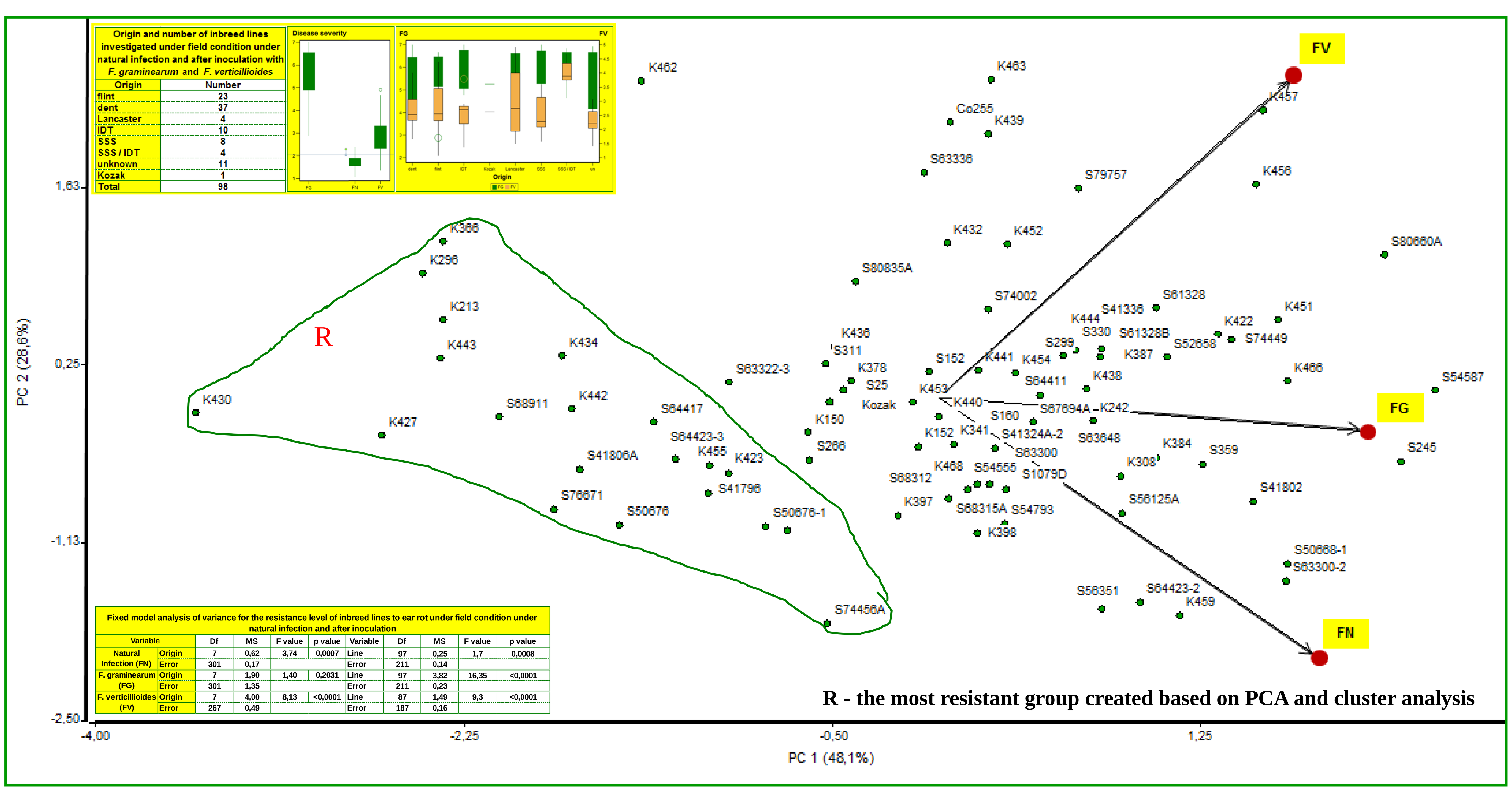
Visual assessing - ear rot severity
Sampling





LOCAL SOURCES OF RESISTANCE

Relations between inbreed lines in the system the first two principal components created based on data of resistance to ear rot under natural infection and kernel inoculation by *F. graminearum* and *F. verticillioides* in the 2011.



Origin and number of inbreed lines investigated under field condition under natural infection and after inoculation with *F. graminearum* and *F. verticillioides*	
Origin	Number
flint	23
dent	37
Lancaster	4
IDT	10
SSS	8
SSS / IDT	4
unknown	11
Kozak	1
Total	98

Fixed model analysis of variance for the resistance level of inbreed lines to ear rot under field condition under natural infection and after inoculation

Variable		Df	MS	F value	p value	Variable	Df	MS	F value	p value
Natural Infection (FN)	Origin	7	0,62	3,74	0,0007	Line	97	0,25	1,7	0,0008
	Error	301	0,17			Error	211	0,14		
F. graminearum (FG)	Origin	7	1,90	1,40	0,2031	Line	97	3,82	16,35	<0,0001
	Error	301	1,35			Error	211	0,23		
F. verticillioides (FV)	Origin	7	4,00	8,13	<0,0001	Line	87	1,49	9,3	<0,0001
	Error	267	0,49			Error	187	0,16		

R - the most resistant group created based on PCA and cluster analysis

EXOTIC SOURCES OF RESISTANCE

Introduction of sources of resistance collected from regions where diseases are endemic, such as Argentinian maize growing where host pathogen coevolution occurred since ancient times, can provide new resistance genes for ear rot.

For using those genes, genomic localization and information on how they respond to prevalent strains in local conditions is currently needed.

Based on cooperation between PBAI-NRI and INTA, the most important Argentinian sources of resistance were already introduced into Poland and were crossed by local sources of resistance – inbreeding lines selected under natural infection and kernel inoculation by *F. graminearum* and *F. verticilioides*.

The host range composed by crosses between Argentinian and Polish sources of resistance will be tested during two years for disease resistance in each country after inoculation with the most representative local strains from the two fungal groups.

The relative contribution of each source and its stability across such a wide range of pathogenic and environmental conditions aiming to check hypotheses about that broad based resistance to *Fusarium* exists will be assesed.

CONCLUSIONS

GRAIN MYCOTOXIN CONTAMINATION

- Poland has variable weather conditions – with big differences between regions and years. It is influenced by a mild oceanic climate from the west and a dry continental climate from the east.
- Across 2008 – 2010 regional differences in ear rot severity, grain mycotoxin concentration and proportion of *Fusarium* spp. in grain were quite large.
- Effect of genotypes on the level of the toxin contamination in the kernel samples and on the *Fusarium* spp. population was observed.
- The highest amount of *Fusarium* spp. toxins were in grain samples collected at Kobierzyce.
- Because in some kernel samples, collected from hybrids commonly grown in Poland, contamination of DON and FUM was higher than EU norms, disease control is necessary.

LOCAL SOURCES OF RESISTANCE

- Inbreed lines which are commonly used in Polish breeding programmes belong mostly to 2 distinct genetic categories: flint and dent. However, lines from Lancaster, IDT and SSS groups are also introduced.
- Disease severity and selection presure after inoculation with *F. graminearum* was much higher than after inoculation with *F. verticillioides* (what was afected also by climate condition).
- Lancaster, IDT, SSS and SSS/IDT groups were characterized as a most susceptible to ear rot after inoculation by *Fusarium* spp.
- Resistant and moderate resistant genotypes belong mostly to flint and dent groups. New, more effective, sources of resistance for ear rot are needed.