



FUSARIUM COMPLEX, MYCOTOXINS AND BIOMASS CONTENT IN MAIZE GRAIN SAMPLES COLLECTED IN POLAND ACROSS 2008 - 2011

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According to EUROSTAT, the cropping area within the 27 member states of the EU reached approximately 13 million ha in 2009. Poland is as a fifth maize producing country after France, Germany, Hungary and Romania (419 thousands ha for silage and 274 thousands ha for grain).

Fusarium spp. causing ear rots are the most economically significant diseases in most European regions and, with the exception of Spain, are an increasing problem in Europe, including Poland. Mycotoxins produced by those fungi represent a risk to human and animal health. A recent survey conducted on grain samples from commercial hybrids in the main Polish maize growing regions revealed that levels of deoxynivalenol and fumonisins may be higher than those accepted by the EU.

Still integrated high-tech crop protection system for maize was not created. One of the most important element of such system, which should be improved is ear rot control. No efficient chemical control of this disease in the field is possible. Prevention relies on other methods such as using of genetic resistance, which besides of being a technology easily accepted by farmers do not cause environmental undesirable effects.

There is a need to more deeply characterize of the host by pathogen by environment interaction, to conclude which elements are as strategic one and help to predict level of the disease

In Poland, compared to wheat, much less is known about epidemiology and mycotoxin production of *Fusarium* spp. commonly connected with maize.

OBJECTIVE

The main goal was to evaluate diversity for DON and FUM content in collection of maize grain samples collected in different regions of Poland, characterize the maize by *F. graminearum* and *F. verticillioides* by environment interaction under Polish conditions and estimate if PCR methods corresponding to microscope method used to predict level of the disease

MATERIALS AND METHODS

As a total 333 maize grain samples were collected from hybrids under natural infection in the trials conducted in 4 regions of Poland across 2008 – 2011 (Fig. 1)

(1) Central region was represented by Radzikow

(2) West-Central region was represented by Smolice, Kościelna Wieś

(3) South-Western region was represented by Kobierzycze and Zbyszow

(4) South-Eastern region was represented by Przecław and Węgrzyce

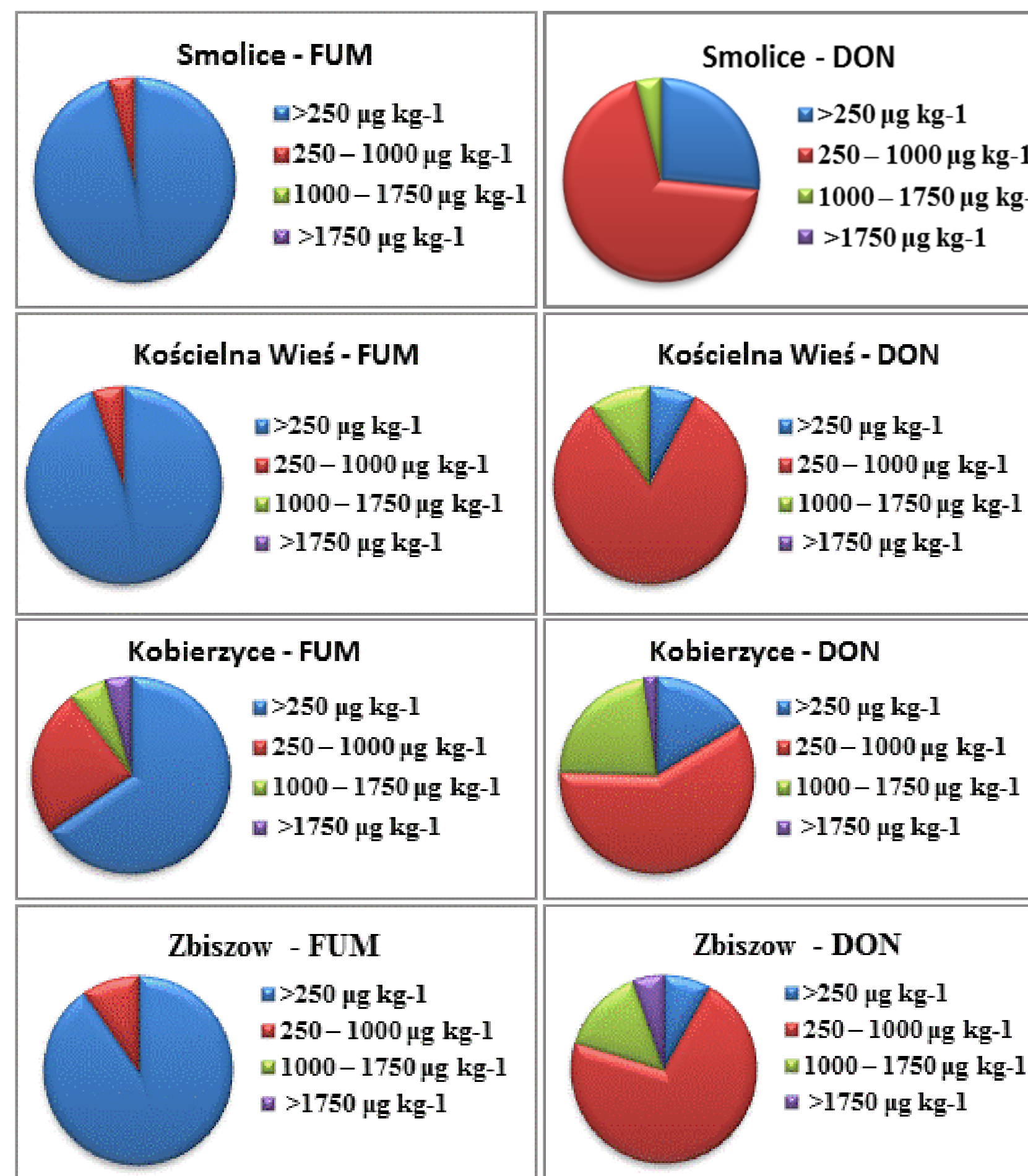
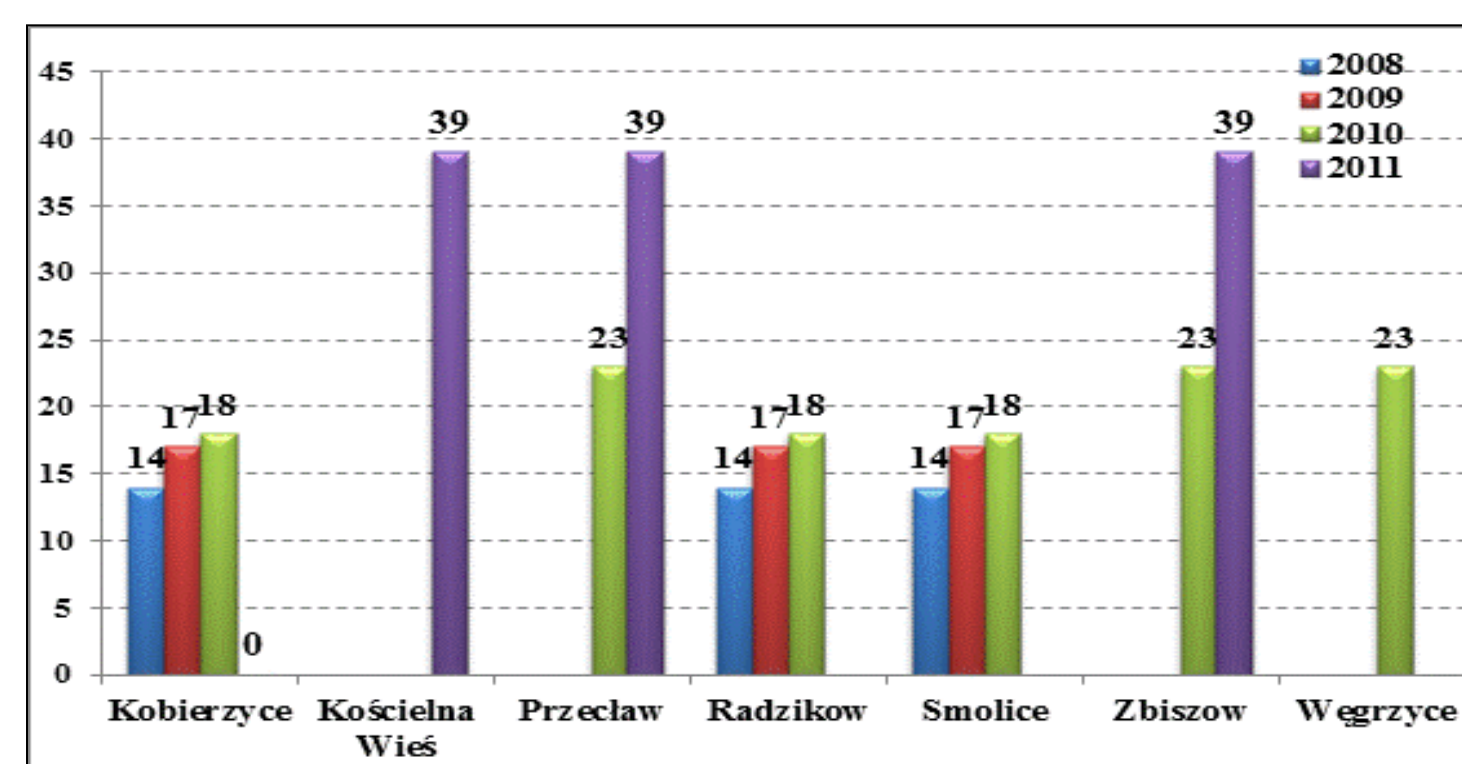
List of the sampled hybrids: Alduna, Amadeo, Ambrosini, Amaroso, Blask, Bosman, Crispi, DKC2960, DKC2971, DKC3420, Es Chromo, ES Kongress, ES Palazzo, ES Paroli, Friderixx, Gavot, Geoxx, Glejt, KOB 1902, KOB 1903, KOB 2704, Kosmo, Kozak, KWS 5133 ECO, Laurelis, Lavena, Lokata, MAS20F, MT Maksym, Nerissa, NK Eagle, NK Falkone, NK Nekt, NK Ravello, Opoka, P800, Podium, PR 39H32, PR 39R86, PR 38A79, PR 38N86, Prollx, Rataj, Reduta, Ricardino, Ronaldino, Rywal, Smok, Smolik, Smolito, Subito, Sumas, SY Cooky, SY Mulitop, Tiberio, Tur, Wiarus, Zidane.

Based on tasseling time, genotypes were divided into 3 groups: early (FAO > 230), medium early (FAO 230 – 250) and middle late (FAO >250) .

In each sample grain DON and FUM content was assessed using ELISA methods and kernel colonization by *F. graminearum*, and *F. verticillioides* was assessed by fungal morphology under microscope.

DNA level of *F. graminearum*, and *F. verticillioides* was determined for by RT-PCR in 63 samples collected from 7 hybrids growing in Smolice, Kobierzycze and Radzikow in 2008 – 2010. For DNA extraction modified CTAB method buffer was used. PCR analyzes were performed on the ABI 7500 apparatus (Applied Biosystems) with the use of SybrGreen fluorescent dye and species specific primers. The amount of fungal DNA was calculated from cycle threshold values using standard curve and results were normalized with the amount of plant DNA calculated on the basis of reference gene assay.

Meteorological data were analyzed for each locality separately. Rainfall, max temperatures and mean temperatures were monitored from tasseling time to harvesting time (July, August, September).



RESULTS

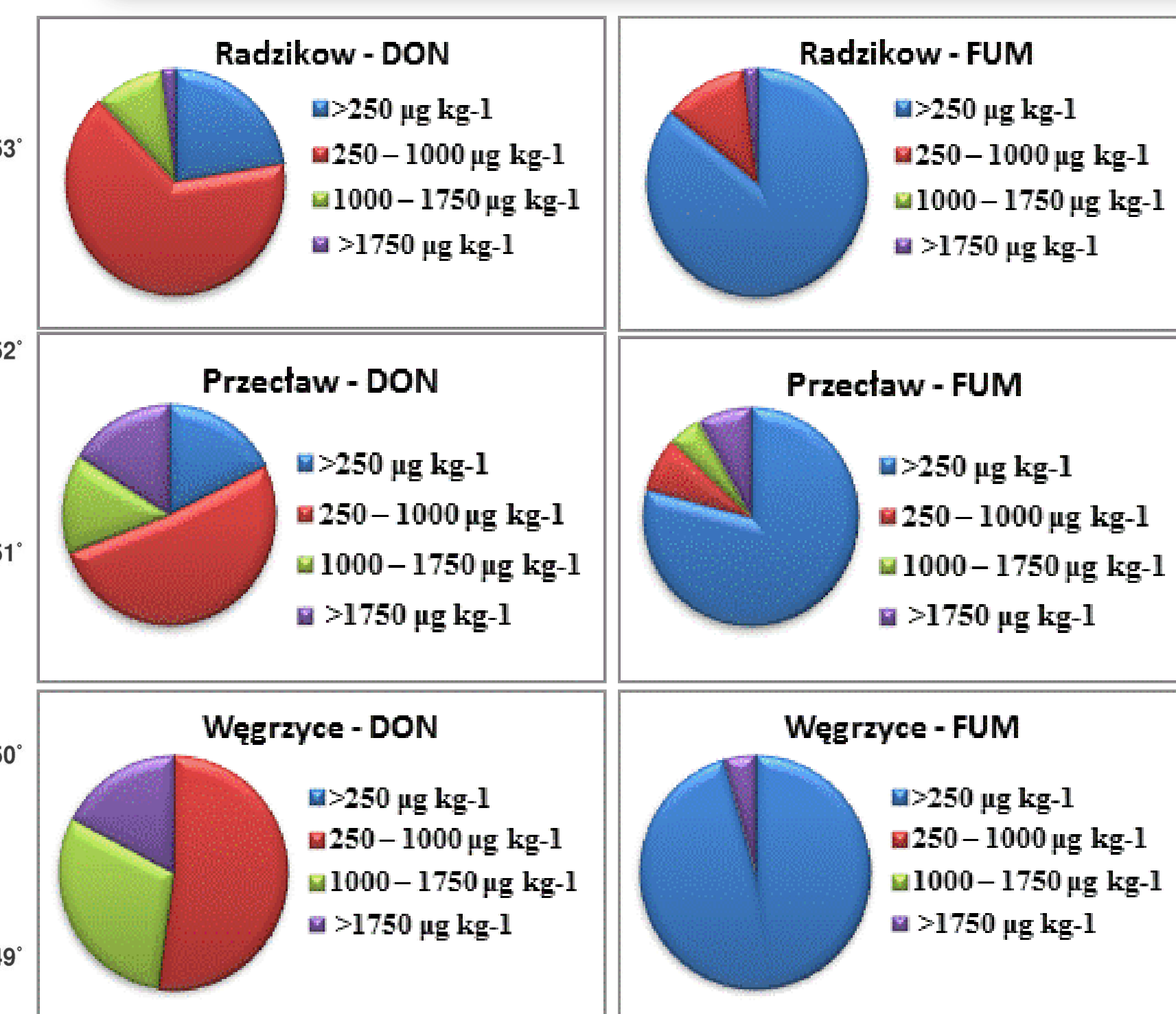
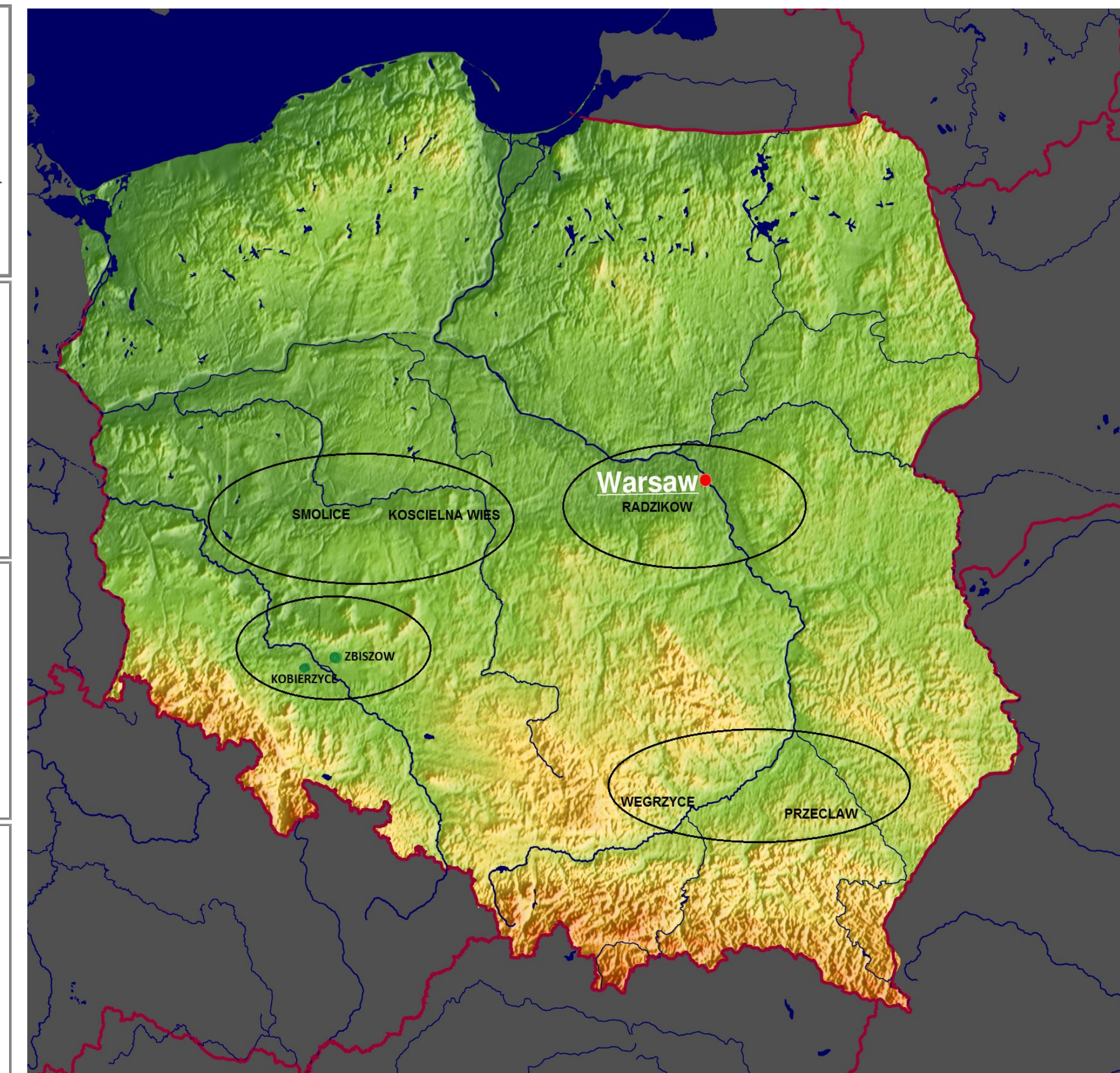


Fig. 3. Percentage of maize grain samples with different level of DON and FUM content collected from the genotypes growing in trials localized in 3 regions of Poland (7 locations) across 2008 - 2011

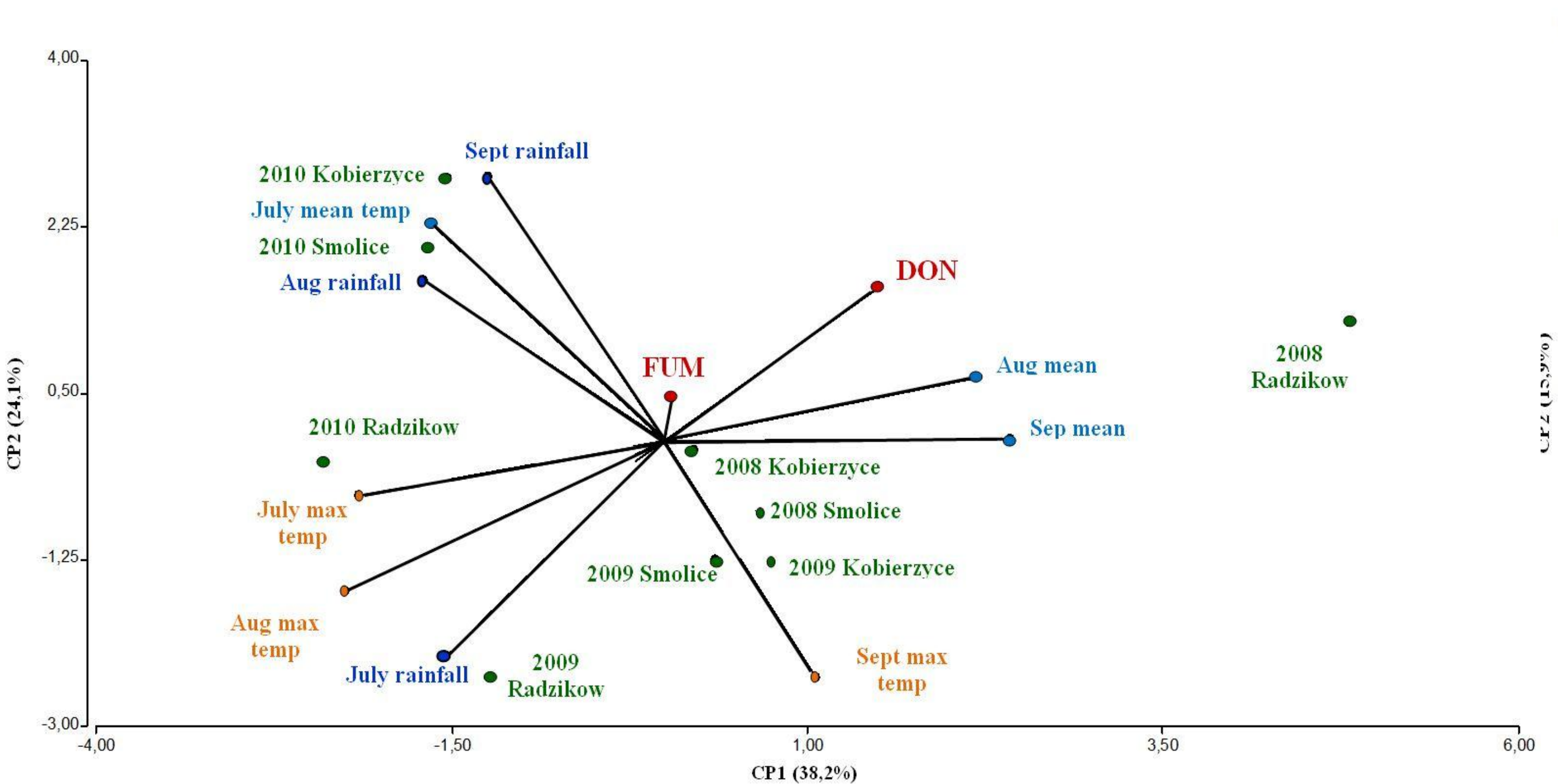


Fig. 2 Relations between ear rot, toxin content and weather conditions in the system the first two principal components created based on data from the trials conducted for genotypes growing at Radzikow, Kobierzycze and Smolice in 2008 - 2010

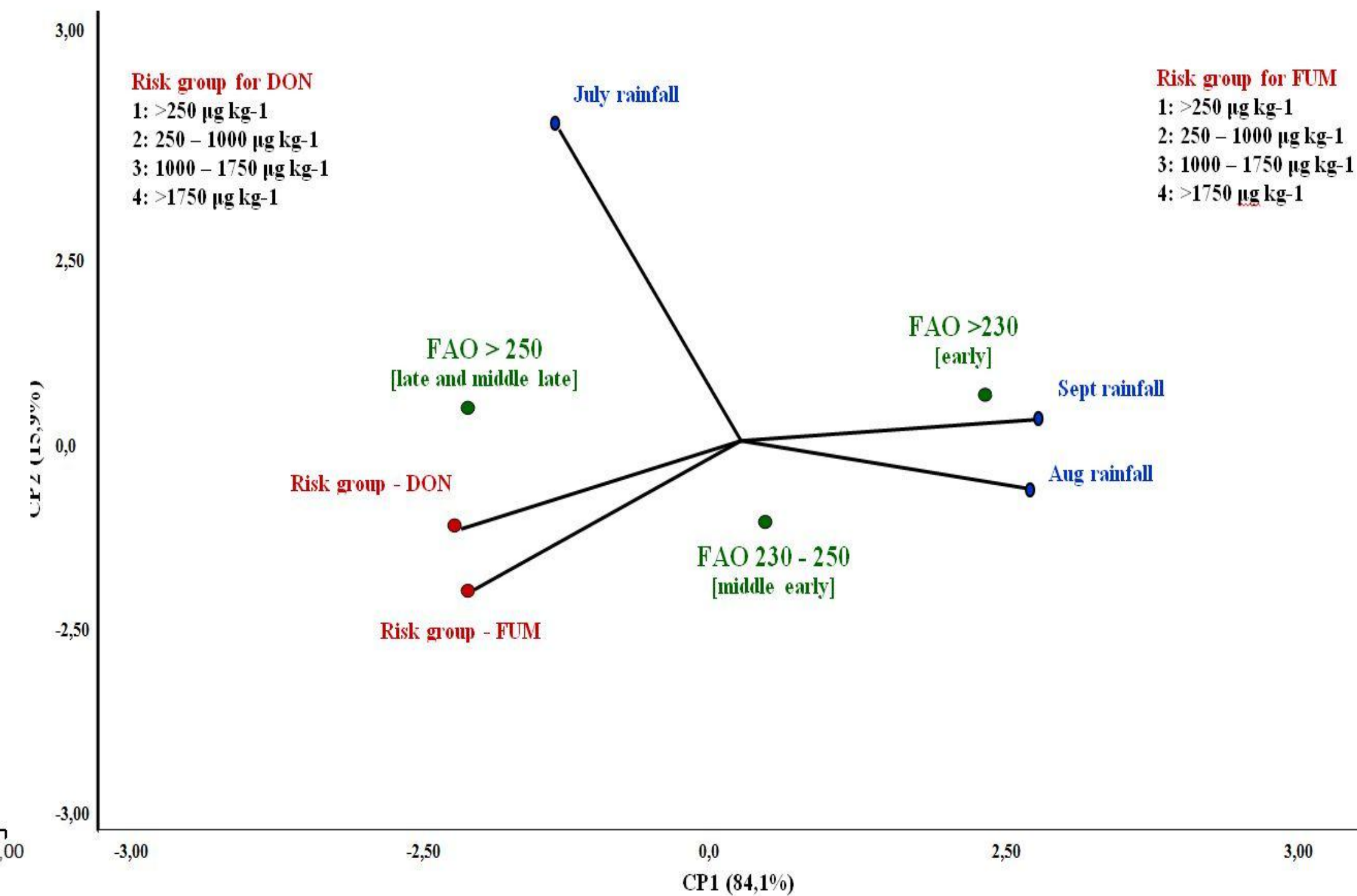
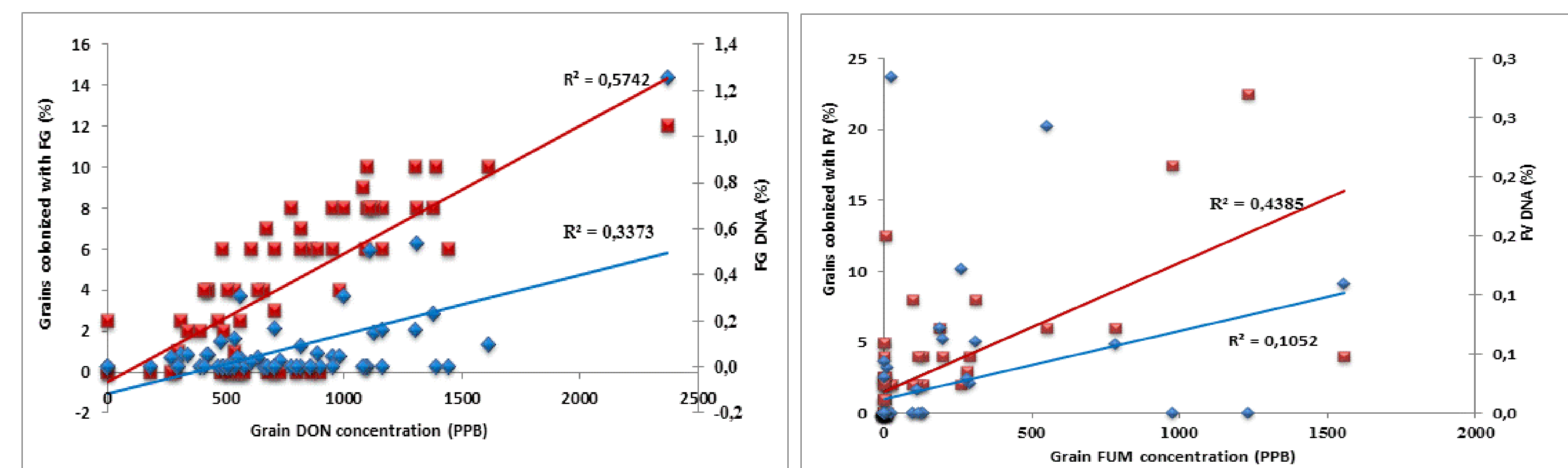


Fig. 3. Relations between tasseling time, toxin concentration and rainfall in the system the first two principal components created based on data from the trials conducted for genotypes with different FAO group at 4 regions (7 localities) of Poland across 2008 - 2011



Relations between grain DON or FUM concentration, grains colonizations by *F. graminearum* and *F. verticillioides* and content of their DNA

CONCLUSIONS

- Studies using fungal morphology confirmed with RT-PCR revealed that, in this samples of maize grown in the main maize growing regions from Poland, *F. graminearum* was the prevalent species and *F. verticillioides* was present in minor proportions.
- Most maize kernel samples collected from hybrids grown in different part of Poland contained DON. Fumonisin were not detected or their levels were much lower than those observed for DON.
- Differences of grain DON and FUM concentration between different regions of Poland were quite large.
- In grain samples collected in the South-Western part of Poland DON concentration was also high. In 25% of samples collected at Kobierzycze and in 20% of samples collected at Zbyszow DON level was higher than 1000 µg kg⁻¹. Additionally, it was possible to observe differences between both localities for fumonisins. More than 35% of tested samples from Kobierzycze contained fumonisins.
- At Radzikow, grain DON concentration higher than 1000 µg kg⁻¹ was detected in 10% of tested samples and 20% of samples contained fumonisins.
- The lowest level of DON and FUM concentration was observed in samples collected at Smolice and Koscielna Wies (West –Central part of Poland). At Smolice only 5% contained more than 1000 µg kg⁻¹ DON or some fumonisins.
- Under Polish conditions the most important effect for grain DON concentration have mean temperatures of August and September. Maximum temperatures and rainfall in July negatively correlated with level of this toxin.
- Tasseling time have significant effect for grain DON and FUM concentration. Highest level of such toxins was observed in the middle late group of tested hybrids. Because of this for regions with risk of the disease hybrids with FAO lower than 250 are recommended.
- Results from this research suggest that Fusarium infection depends on environmental conditions and hybrid earliness. Further information is needed to develop models predicting the level of mycotoxin contamination occurring on the field conditions.
- 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

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