

RELATIONSHIP BETWEEN THE VIABILITY OF MAIZE-POLLEN AND QUANTITY OF CROP

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Introduction

The maize (*Zea mays* L.) is one of the most important comestible and fodder plant in the World. In Hungary yearly we produce cca. 500.000 t maize in 1.200.000 ha. The best hybrid breeds are able to produce the highest yield and the primest quality among optimal environmental circumstances. The maize is an allogamic plant, thus the amount of yield is influenced by the viability of pollens responsible for fertilization.

The viability of pollen is genetically determined, but the environmental factors have great impact as well. We are discussing in this paper about the relationship between the viability of maize pollen and the fertilization. Corn pollens are classified into the so-called short-lived pollens' group (Pfundt 1910, Holman-Brubaker 1926, Vasil 1961, Kozaki 1975 in Barnabás 1982).

In our experiments we investigated the effects of UV irradiations, the N-fertilization and the moisture on the viability of pollens.

Methods

The experiments were carried out in Martonvásár (Hungary) in 2004. We used the parental lines of three Hungarian public cropping strains (Table 1.). The three experimental plots were supplied with different doses of nitrogen: 0, 80 and 120 kg/hectare N supply, respectively.

Daily totals of biologically effective UV irradiance used for the study were measured by a UV-Biometer Solar Light Model 501A operated by the Hungarian Meteorological Service. The data acquisition was carried out on 10 minute basis and from the 10 minute averages, daily totals were computed. The output biologically effective dose is valid for the sensitivity range of the detector that is between 280 and 400 nm. The unit is MED/h for the 10 minute averages and MED for the daily doses. 1 MED/h would cause minimal redness of the average number 2 skin after a one hour irradiation. The integral of the cross-multiplication of irradiating flux ($W\ cm^{-2}\ nm^{-1}$) and the Erythema Action Spectrum (McKinlay and Diffey 1987) gives the effective power. $1\ MED/h = 5.83 \cdot 10^{-2}\ W\ m^{-2}$ of effective power as momentary radiant flux density. In case of temporal integration (for example hourly or daily total) the unit becomes MED that equals to $21\ mJ\ cm^{-2}$. Since the slope and wavelength range of other action spectra observed in the nature is very similar to that of human skin, the values measured by this detectors indicate effectiveness of solar radiation even for other biological systems. The detector is calibrated according to the QA/QC procedure of the Hungarian Meteorological Service (ISO 9000:2001).

In 2003 We sowed on 13th May, and the flowering was from 3rd to 10th August.

Table 1.
Inbred and hybrid strains used in the experiment

Breed	Strain
Norma	NA
	NB
Maraton	MA
	MB
Gazda	GA
	GB

At the laboratory, the viability of pollen grains was examined, by painting with TTC-solution (triphenil-tetrazonium-chlorid) and by counting under microscope. The TTC reacts with one of the respiratory enzyme functioning in cells. If the pollen grain contains the enzyme, than the TTC paint it to red colour. The tint of the red colour depends on the activity of the enzyme. The pollen grains with light red colour are viable and fertile. The pink coloured grains are viable, but according to our experience they are not fertile. The respiratory enzyme in the pollen grains remained yellow is inactivated.

The measurements were repeated three times, with 30 minutes intervals and with 120 minutes total duration. After dispersing the solution we put the samples into a 37 °C thermostat for 15 minutes, to get the proper colour reaction.

Results

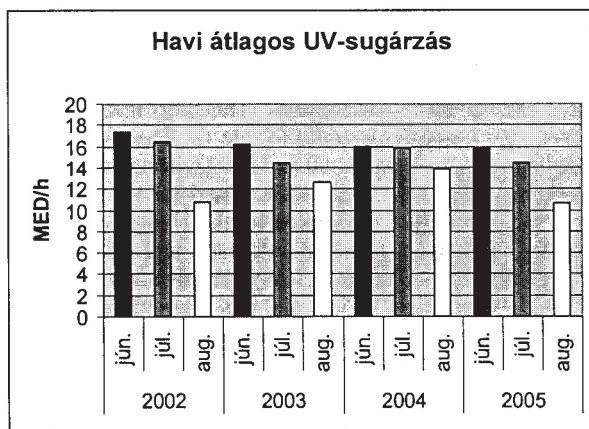


Figure 1.

The results confirm our hypothesis that the N-supply has a positive effect on the viability preservation time of maize pollen. On the next figures, we can trace the change in the viability of pollens in one of the inbred (MB) and one of the hybrid parental strains (GA), depending on the different amount of N fertilization.

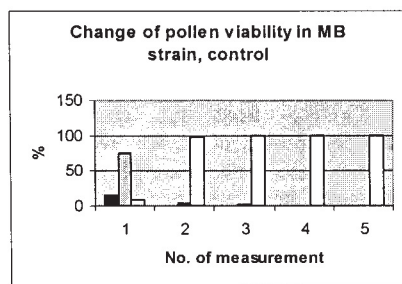


Figure 2.

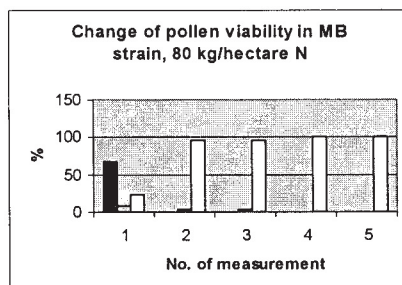


Figure 3.

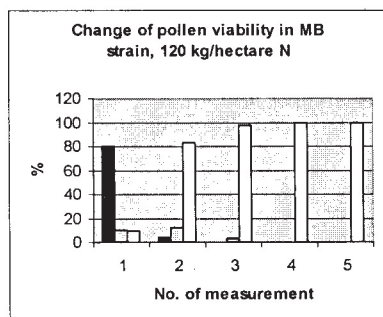


Figure 4.

On the second, third and fourth figures we can trace the decrease of pollen viability in case of MB inbred strain. There is a significant difference between the samples deriving from the control and the 80 kg/hectare supplied experimental plots. The rate of fertile pollen grains in the control samples has been already low in the first measuring time, but in case of moderately N supplied group, 60 % of the pollens were light red.

Further experience was that the pollen grains reserved their viability for a longer time in the second group.

On Figure 5; we can see the change of the viability of pollen grains deriving from the 120 kg/hectare N-supplied plot. In case of first measurement we found the highest rate of fertile pollen grains in this group. Additionally, higher rate of fertile grains were found in the further measurements, than in the previous two groups.

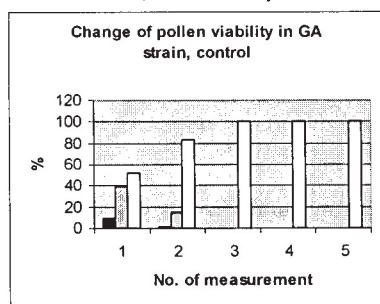


Figure 5.

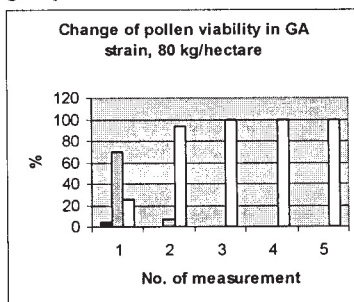
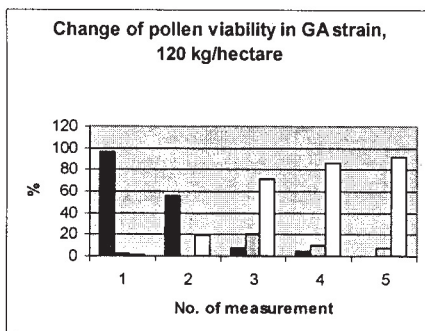


Figure 6.



On Figures 5, 6 and 7; we can trace the change of pollen viability in case of GA strain. We did not find significant difference between the samples deriving from the control and moderately N-supplied plots. But we have to notice at the same time, that the results are slightly better in case of the previous mentioned, MB inbred line

Figure 7.

In case of samples deriving from the 120 kg/hectare N-supplied plot, the differences are significant compared with the moderate supplied plots, as well as with the inbred strain. The rate of fertile pollens was extremely high, close to 100 % and the longevity was also favourable: after 90 minutes we still found fertile grains.

Conclusion

According to our results, we can state that the effect of N-supply on the viability and longevity of pollens is determining. The 120 kg/hectare N-supply generated the best results, so practical using of such a dose can increase significantly the yield. Furthermore, we can state, that the effect of nutrients were higher in case of the hybrid strains, which can be consider as the effect of heterosis.

Az UV-sugárzás káros hatását avval szemben ellenálló vonalak nemesítésével csökkenthetjük. Azokkal az agrotechnikai beavatkozásokkal tehát, amelyek elősegítik a pollen élettartamának növelését, a termésmennyiség és -minőség is kedvezőbb lehet.

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