

Relationships between microclimate, desiccation rate and seed vigour in beans (*Phaseolus vulgaris* L.)



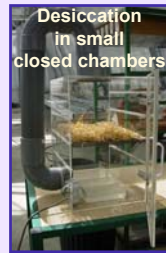
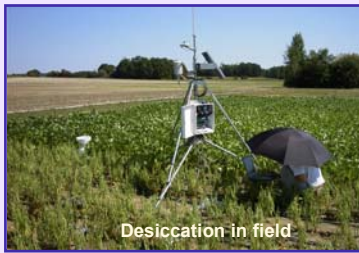
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Aim

The aim is to establish the relationship between seed production conditions and seed vigour at harvest.

1. Results from previous studies (Coste *et al.*, 2002) showed that seed quality at harvest could mainly depend on seed desiccation rate.
2. As for all solids (Goenaga, 1968), seed drying should depend on microclimate, i.e. temperature and relative humidity near the pods.



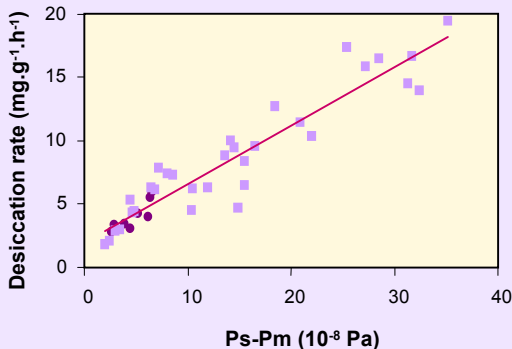
Materials and methods

After the end of seed filling, pods were dried either in small closed chambers where relative humidity (RH) was controlled by using different salt solutions and temperature (T) regulated, or in the field by water spraying, hand defoliation and sowing dates which created gaps between desiccation phases.

Seed water content was measured at least twice a day throughout the seed desiccation on the seeds of ten pods.

Seed vigour was measured by 11 (SG11) and 15 (SG15) day controlled deterioration tests (seed water content: 16%; 11 or 15 days of controlled deterioration at 40°C; sowing in sand boxes and growing 7 days at 20°C; standard germination (SG) evaluation).

1 Using microclimate parameters for seed desiccation rate modelling



● Field (2002)
 ■ Chambers (2001-2002)

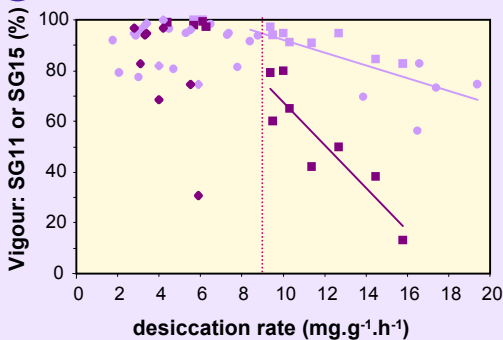
Regression line:
 $y = 0.46x + 1.96$
 $R^2 = 0.891$

The difference between Ps (saturation vapour pressure) and Pm (partial moisture pressure) reflects the air drying capacity. It directly depends on temperature and relative humidity (Goenaga, 1968). Either in field or in chambers, desiccation rate linearly depended on the difference between Ps and Pm:

$$\text{Desiccation rate (mg.g}^{-1}\text{.h}^{-1}\text{)} = 0.46 (\text{Ps} - \text{Pm}) + 1.96$$

Validation of the model will be done shortly on data from 2003 experiments.

2 Seed desiccation rate and vigour



● SG11 2001 chambers
 ■ SG11 2002 chambers
 ● SG15 2002 chambers
 ● SG11 2002 field
 ● SG15 2002 field

Regression lines:
 SG11: $y = -2.5x + 117.4$
 $R^2 = 0.584$
 SG15: $y = -8.4x + 152.2$
 $R^2 = 0.817$

For slow desiccation rates, vigour remained at a high level. But beyond a threshold of about 9 mg.g⁻¹.h⁻¹, vigour decreased as desiccation rate increased. Loss of vigour was more pronounced for 15 day controlled deterioration.

No differences were noticed between field or chambers desiccation conditions, excepted for the first sowing date of 2002: desiccation rate was not constant and a sharp drop of water content could be the cause of lower vigour.

SG11 and SG 15: 11 or 15 days controlled deterioration before standard germination evaluation

Discussion and conclusion

1. The model that links desiccation rate to the difference (Ps - Pm) (calculated from the mean temperature and relative humidity during the desiccation) remarkably fitted the data either from the quite stable microclimate in the closed chambers or from the fluctuating parameters in the field. However, the microclimatic parameters at the pod level were different from the weather parameters; so, for a decision oriented model, another submodel will have to be developed.
2. Seed vigour decreased when desiccation rate increased above a threshold of about 9 mg.g⁻¹.h⁻¹. 2003 data should corroborate this threshold and the impact of high desiccation rates during short periods of the desiccation. Controlled deterioration test is not enough to evaluate all the aspects of seed vigour and to predict seedling emergence. So, seed desiccation effects has to be studied on other seed vigour characteristics.