Seed vigour

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Factsheet about integrated weed management

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Introduction

An important component of the performance of crop seeds, including suppressiveness of the crop against weeds, is the complex trait of seed vigour. Using vigorous seeds promotes the competitive ability of the crop against weeds. "Seed vigour is the sum of those properties that determine the activity and performance of seed lots of acceptable germination in a wide range of environments" . It is not a single measurable property, but associated with seed performance aspects, including: the emergence ability of seeds under unfavourable conditions, rate and uniformity of seed germination and seedling growth; and performance after storage, especially the retention of the ability to germinate.

Figure 1| Freshly harvested seeds of quinoa

Applicability

Using vigorous seeds does not require any other inputs besides the seeds themselves. Because the seed vigour is mainly determined in the process before it arrives at the farm to be sown, it is hard to examine seed vigour as a farmer. However, there are some points of attention that determine seed vigour:

- Storage time: Seed vigour begins to decline from physiological maturity as seeds age before and after harvest, and finally the seed loses viability during storage[2].
- A constant temperature and air humidity during storage minimizes loss of vigour. Most crop seeds are desiccation tolerant and can be stored and transported in a 'dry' state with minimal loss in their ability to grow[2].
- The International Seed Testing Association (ISTA) have a vision of 'uniformity in seed quality evaluation worldwide' and provide a framework[1] to evaluate and compare the quality. Seed lots need to:
    - Be genetically pure
    - Be free from physical damage and disease (figure 2 and 3)
    - Have high viability so that almost all seeds complete germinate and produce normal seedlings.

Figure 2| Caraway seeds

Figure 3| Clean homogeneous kidney beans

1| International Seed Testing Association. (2022). Chapter 7: Seed health testing. In International Rules for Seed Testing (Vol. 2022, pp. i-7-6).

1| Finch-Savage, W. E., & Bassel, G. W. (2015). Seed vigour and crop establishment: extending performance beyond adaptation. Journal of experimental Botany, 67(3), 567-591. doi:10.1093/jxb/erv490

Efficacy and what to consider

Seed vigour can be considered as the potential performance of viable seeds, which is determined by the complex interaction between environmental and genetic components. About the regulation of seed dormancy and germination a great deal is known but little research has been done for the understanding what mechanisms determine the initial vigour of seeds in an agricultural context, rather than the consequences of environmental variation2. Three key seed vigour traits have been identified as necessary for good establishment across a wide range of seedbed conditions:

- The seed must germinate rapidly
- The seed must have rapid initial downward growth
- The seed must have high potential for upward shoot growth in soil of increasing impedance[3].

Besides that seedlings from vigour seeds are more resilient, the timing and uniformity of crop seedling emergence has immediate impact upon the efficacy of herbicide applications and the weeding strategies. Early vigour is a trait that adds up to the suppressiveness ability of cultivars because the associated early growth rate expresses a rapid emergence, early leaf area development, thus an early crop cover[4][5][6].

Core results

- In a two-year experiment artificial reduced seed vigour caused a reduction in germination rate, delayed time of emergence and, as a result, a reduced competitive ability against weeds. Average weed biomass was reduced by 169% and 210% in both years of the experiment, and without the influence of weeds, the average crop yield was reduced by 16% and 21% in the two years[8].

Extra information

See https://iwmpraise.eu/publications/ for all crop diversification strategies and their definitions, and for more information on integrated weed management.

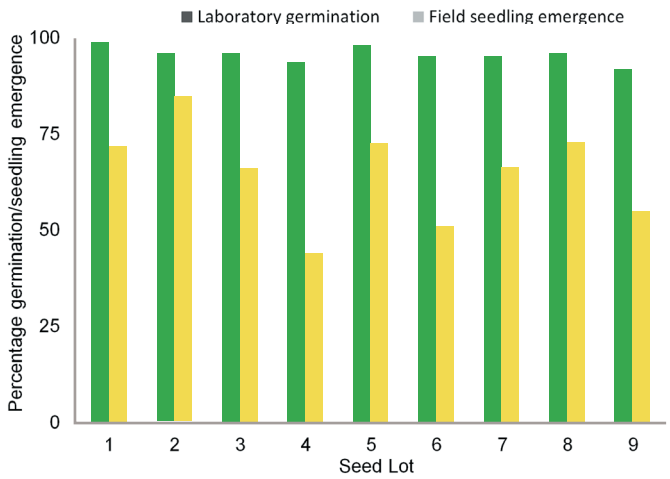

Figure 4| Differences in seed vigour cause differences in field performance, as follows from this comparison of nine commercial sugar beet seed lots with the percentage germination in standardized laboratory germination tests (green columns) and percentage seedling emergence after sowing under commercial field conditions (yellow columns). The germination tests carried out under near optimal conditions (laboratory germination) cannot statistically distinguish between the seedlots while difference in vigour result in very different field performance (field seedling emergence) under field conditions. Adapted from Finch-Savage and Bassel (2015)[3].

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5| Drews, S., Neuhoff, D., & Köpke, U. (2009). Weed suppression ability of three winter wheat varieties at different row spacing under organic farming conditions. Weed Research, 49(5), 526-533. doi:https://doi.org/10.1111/j.1365-3180.2009.00720.x

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7| Finch-Savage, W. E., & Bassel, G. W. (2015). Seed vigour and crop establishment: extending performance beyond adaptation. Journal of experimental Botany, 67(3), 567-591. doi:10.1093/jxb/erv490

8| Rasmussen, & Rasmussen. (2008). Barley seed vigour and mechanical weed control. Weed Research, 40(2), 219-230. https://doi.org/10.1046/j.1365-3180.2000.00184.x