

1 POPULATION-BASED THRESHOLD MODELS DESCRIBE EFFECTS OF CONTROLLED
2 DETERIORATION ON SEED RESPIRATORY PATTERNS DURING GERMINATION

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7 Cellular respiration is initiated during the early stages of seed imbibition. Understanding the dynamics of seed
8 respiration during germination provides new opportunities to optimize treatment protocols and to assess seed
9 quality. Previous approaches to measure seed respiration have largely relied on measurements of samples
10 containing many seeds, making it difficult to relate specific respiratory patterns to germination timing. The Q2
11 instrument (ASTEC Seed Technology) allows the sensitive measurement of respiration (oxygen depletion in
12 sealed vials) by individual seeds enabling more detailed studies of the relationships between respiration and
13 germination rates. Methods were developed to display respiratory data in a manner analogous to germination time
14 courses that illustrate both the timing and variation in respiratory activity among seeds. The time required for
15 germination increases prior to the loss of viability as seeds deteriorate during storage. Population-based threshold
16 models have been created successfully to quantify and predict seed germination times and percentages after
17 ageing periods under controlled deterioration. The model relies on measurements of germination rate that is very
18 labor intensive. We characterized the effects of controlled deterioration ageing on respiratory patterns of lettuce
19 seeds in comparison with their germination kinetics. The respiratory response to ageing was consistent and highly
20 correlated with germination; delays in both germination and respiration were observed and exhibited linear
21 relationship with ageing. Respiratory information automatically generated from the Q2 instrument can be used
22 instead of germination rates and valuable parameters can be extracted from a population-based threshold model to
23 provide indicatives of expected shelf life.

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25 Keywords: Controlled deterioration, ageing, germination, respiration

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