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## Low oxygen sensing and balancing in plant seeds: a role for nitric oxide

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### Abstract:

Storage product accumulation in seeds of major crop species is limited by their low internal oxygen concentration. Adjustment of energy and storage metabolism to oxygen deficiency (hypoxia) in seeds is highly relevant for agriculture and biotechnology. However, the mechanisms of low-oxygen sensing and balancing remain a mystery. Here, it is shown that normal hypoxia in seeds of soybean (*Glycine max*) and pea (*Pisum sativum*) triggers a nitrite-dependent increase in endogenous nitric oxide (NO) concentrations. NO, in turn, reduces the oxygen consumption of seeds, generating a localized decrease in both ATP availability and biosynthetic activity. Increasing oxygen availability reduces endogenous NO concentrations, thereby abolishing mitochondrial and metabolic inhibition. This auto regulatory and reversible oxygen balancing, via NO, avoids seed anoxia and suggests a key role for NO in regulating storage activity. This hypothesis is reinforced by changes in energy status (ATP: ADP ratio), steady-state metabolite concentrations and biosynthetic fluxes under NO treatment. The proposed mechanism of low-oxygen sensing and balancing in plants offers the prospect of a new field of study in crop biotechnology.

Key-words: ATP availability, crops, hypoxia, membrane inlet mass spectrometry (MIMS), oxygen sensor, microsensor, seed photosynthesis, storage metabolism