Growth of pea (Pisum sativum) under conditions for accelerated maturity shifts the expression pattern of key hormones related to embryo physiological maturity

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The University of Western Australia (UWA) has partnered with The Grains Research and Development Corporation (GRDC) to undertake research aimed at delivering rapid genetic gain in pulses through the deployment of an accelerated single seed descent (aSSD) platform. Manipulation of key growth conditions, including photoperiod, light quality and temperature, has enabled the substantial shortening of time to maturity across the five major cool-season pulse species. A key aspect of the aSSD platform research has been determining the timing at which robust precocious germination of the immature seed is achievable. We have previously established sugar and moisture content as indicators of physiological maturity in pea. In the research reported herein, we now address the question of how hormone profiles are regulated by plant growth environment and the relevance of these fluctuations to precocious *in vitro* germination.

Three pea cultivars (PBA Twilight, PBA Pearl and Kaspa) defined as early, mid and late based on field flowering time were grown under two environments. Environment 1 (E1) was a controlled environment room set at a 20 h photoperiod provided by LED AP67 arrays (Valoya, Finland) to promote rapid maturity. Environment 2 (E2) was a glasshouse with a 13-14 h photoperiod provided by natural light. Temperature of 24/20°C (day/ night) was constant in both environments. The profiles of key embryo development hormones indolacetic acid (IAA), chlorinated IAA (4Cl-IAA), gibberellins (GA_{20} and GA_1) and abscisic acid (ABA) were measured in the developing seed in a period between the end of embryo morphogenesis (10 days after pollination, DAP) and the attainment of embryo physiological maturity (22 DAP).

Growing plants under E1 conditions altered the seed hormone content by advancing the auxin, GAs and ABA profiles by 4-8 days compared to those of seeds grown under E2 conditions. In E1, there was a synchronisation of auxin peaks across the different pea genotypes. GA_1 was only detected in seeds harvested from the less intensive conditions. The results point to an acceleration of embryo physiological maturity by up to four days in the intensive environment and the utility of auxin and GA profiles as reliable indicators of seed maturation. A second experiment aimed to *in vitro* germinate seeds harvested at time-points 12-22 DAP, with and without exogenous hormones. The results demonstrated the extent of sensitivity of developing seeds to exogenous ABA was strongly genotype-dependent. Concentrations between 5-10 µM inhibited germination of seeds harvested 18 DAP. Germination of seeds harvested 12 DAP was enhanced up to three fold with the addition of 125 µM GA_3. These results show for the first time the fluctuations of seed hormone levels across genotypes, stage of seed development and environmental conditions and the influence of these changes on precocious germination competence in pea.