Light quality parameters affecting flowering and morphology responses differ among pulse species

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Rapid progression to flowering is a key component in the accelerated single seed descent (aSSD) platform developed at The University of Western Australia in partnership with The Grains Research and Development Corporation (GRDC). This rapid flowering response is achieved through manipulation of *in vivo* growth conditions, including photoperiod, light quality and temperature, and has enabled the substantial shortening of time to maturity in long-day pulse species. Our previous research demonstrated that the ratio of red to far-red (R:FR) light was a significant contributor to a rapid flowering response (Croser et al 2016), possibly via a mechanism related to the shade-avoidance response (Runkle and Heins 2001). However, flowering and morphology responses to other parts of the spectrum have not been well explored in the pulse legumes, and the blue (B) portion of the spectrum is also known to contribute to flowering time responses. We set out to explore the effect on pulses of these other aspects of light quality with the aim of further improving our light environments for rapid flowering time and plant health.

A single, late-flowering cultivar was selected of lentil (Northfield), lupin (Tanjil), chickpea (Rupali), faba bean (Icarus) and field pea (Kaspa) and grown in four environments with identical temperature (24/20ºC), light intensity (340 µmol m-2 s-1) and photoperiod (20 h), but differing in light quality. Light sources were Valoya LED growth lamps (AP67 or AP673 spectra, B-series, Helsinki, Finland) with some modifications using filters to alter the proportion of far-red light (Lee filters, Hampshire SP10 5AN, England). The environments had B:G:R:FR profiles of 11:19:63:7 (AP673), 11:16:56:17 (1st generation AP67), 13:14:58:15 (2nd gen. AP67) and 9:10:57:24 (filtered AP67). Light measurements were made with a Sekonic C7000 SpectroMaster spectrometer (Sekonic Corp., Tokyo, Japan). Days to flower, flowering node, and height of plants at flowering were measured and analysed for response to the proportion of B, R and FR light, and the ratios of B:R, B:FR and R:FR by multiple linear regression (MLR) and principal component analysis.

Our results clearly indicate that responses to light quality differed among the species. Chickpea, lentil, faba bean and field pea had small but significant time to flower responses between approx. 5 and 1.5 days, indicating that the light spectra in tested environments may be close to optimal for these varieties at 20h photoperiod and the tested intensity. Lupin displayed the largest difference in flowering time (fastest – slowest >12 days) and was also the most responsive species to FR light. MLR revealed that B:R or B:FR ratios had the largest effect on flowering time in all species compared to R:FR ratio. Comparing individual portions of the spectra, FR light contributed most to flowering time in lentil, lupin and field pea. Unexpectedly, B light contributed highly to flowering time in chickpea, lupin and faba bean, likely because the environments had sufficient photon load in the FR region.

Recently acquired Heliospectra lights will allow accurate adjustment of spectral composition in our efforts to further optimise the flowering time of pulse legumes progressing through the aSSD platform.