Identification and characterization of heterotic genotypes in lentils for enhanced crop productivity

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Heterosis is the superior performance of an F_1 relative to its parents and this phenomenon has been widely studied and commercially used in a range of crop species including maize, wheat, rice and canola. The conventional breeding programme in lentils produces seed yields of 1.5 t/ha and typically experiences increases in yield by 1.13% p.a. Heterosis in other crops has realised increases of c. 20-50%. By applying heterosis and F_1 hybrid breeding to pulses, dramatic increases in productivity, profitability and sustainability could potentially be realised. The current study aims to evaluate hybrid performance across generations (i.e. F_1 to F_6) by identification and quantification of heterotic traits and germplasm in lentil and to understand the underlying genetic and molecular mechanism of heterosis. High yielding genetically divergent parents were selected to make crosses that could produce heterotic F_1's. In a replicated glasshouse experiment, a total of 72 F_1's along with each parent were evaluated for seed number, seed weight, fresh weight, internode number and height. The top three crosses exhibited 62%, 57%, 31% heterosis for seed number and 57%, 50%, 26% for seed weight, respectively with reference to the better parent. The five best performing heterotic crosses were selected (~200 F_2 plants for each line including parents) with a negative control and were progressed to the next generation for phenotypic and genotypic evaluation. The best performing heterotic lines exhibited higher heterotic percentage at F_2 as compared F_1 for all the yield related parameters. In terms of phenotypic evaluation, the F_2 plants were measured for height and internode number during their life cycle at different time points throughout the duration of the experiment. At the time of harvest, the plants were also evaluated for other yield contributing characters to establish an association between different traits. Correlation coefficients were determined, and seed number was found to be positively correlated with seed weight and plant biomass. A strong correlation was not observed for height and internode number with seed number. This phenotypic evaluation suggests an indirect selection based on component traits. The data across generations will be analysed and compared to understand the phenomenon of heterosis. Based on phenomic observations,

genomics of the most heterotic cross shall be analysed through sequencing to determine possible chromosomal combinations that are responsible for causing heterosis.