Computation of genetic values through the study of successive generations and backcrosses

Case study
- Genotype value for fruit diameter in tomato -
Analysis of heterosis, additivity and dominance and heritabilities in the narrow and broad sense

As part of a tomato breeding program, two varieties were crossed to improve fruit diameter. In order to assess the interest of crossing these varieties, we compare the performance of the parental varieties P1 and P2, of one F1 (P1xP2) and F2 offsprings and of the two back-crosses (P1xP2) x P1 and (P1xP2) x P2.
To this aim, the fruit diameter was evaluated under controlled environmental conditions and identical for all the individuals assessed in the greenhouse.

1. Describe the experimental plan set up for this study. Does it impose to grow all generations at the same time? Draw a schema of the practical implementation of the experimental set up in the greenhouse.
2. Are the parental varieties P1 and P2 genetically different with regard to fruit diameter control? Conclude on the interest of making a cross between these two varieties.
3. Is there a superdominance effect? Justify.
4. Calculate the best estimate of environmental variance (V_E) and broad sense heritability (H^2) for fruit diameter in the population.
5. Calculate the additive genetic variance (V_A) and the variance of dominance (V_D) for this trait.
6. Calculate the heritability in the narrow sense (h^2). Interpret. In your opinion, will it be easy to select a tomato variety improved for fruit diameter during this program?
7. Calculate the additivity (a) and dominance (d) parameters for this trait.
8. Calculate the degree of dominance. Interpret. Do you think it will be easy to select an improved tomato variety for fruit diameter using this program?