**Scientific Training Center in Plant Biotechnology**

*Modern Plant Breeding. Beginner Level. 4th Edition. February, 6-17, 2023*

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Session. ‘Determining the value of genotypes

through the study of successive generations and Backcrosses'

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***Case study. - Value of genotypes for fruit diameter in tomato - Analysis of heterosis, additivity and dominance and narrow and broad sense heritabilities***

As part of a tomato breeding program, two varieties were crossed to improve fruit diameter.

In order to evaluate the interest of carrying out a cross between these 2 varieties in a selection program, we compare the performances of the parental varieties P1 and P2, of the F1(P1xP2), of the F2 and of the two Back-Crosses (P1XP2)XP1 and (P1XP2)XP2 offsprings.

For this, the diameter was evaluated under controlled and identical environmental conditions for all the individuals tested during a greenhouse trial (file: 10\_TomatoSize.xlsx). We hypothesize that there is no genotype-environment interaction effect for the 'Fruit diameter' trait.

1. *Describe the experimental plan implemented for this study. A diagram may illustrate the experimental plan set up in the greenhouse.*
2. *Are the parent varieties P1 and P2 genetically different with respect to fruit diameter? Justify your answer. Conclude on the interest of making a cross between these two varieties.*
3. *Is there an overdominance effect? Justify.*
4. *Estimate the additivity (a) and dominance (d) parameters for this trait. You will indicate the matrix algebra system allowing to obtain the best estimate for these parameters. The coefficients of the design matrix will be specified.*
5. *Calculate the degree of dominance. Interpret. Do you think it will be easy to select an improved tomato variety for its fruit diameter during this program?*
6. *Calculate the best estimate of environmental variance (VE) and broad-sense heritability (H²) for this trait in the population.*
7. *Calculate the additive genetic variance (VA) and the dominance variance (VD) for this trait. You will indicate the matrix algebra system allowing to obtain the best estimate for these parameters. The coefficients of the design matrix will be specified.*
8. *Calculate the narrow sense heritability (h²). Interpret. Do you think it will be easy to select a tomato variety improved for fruit diameter during this program?*

* *Download the dataset in .xlsx format to your computer from github. Above all, do not modify the file or its format!*
* *Import the data into R by writing the command below in a new script that you will have created and saved in the same directory as the one containing the dataset.*

*Tomato <- read.xlsx("10\_TomatoSize.xlsx", sheet = 1)*

