**ALA3 Quantitative and qualitative traits in plant breeding**

**Prerequisites**

eModules 1, 3, 4 in Crop Improvement course: *Refresher on Population and Quantitative Genetics*

MS Excel proficiency

**Purpose**

To learn the concepts of quantitative versus qualitative data, and the effect of genotype x environment interactions in a multi-location trial.

**Background**

Plant breeders deal with two kinds of traits, namely qualitative and quantitative traits. Qualitative traits have generally been considered to be primarily controlled by genes that function according to the laws of Mendel. Quantitative traits are measurable or metric traits. Genotype x Environment interactions (GEI) occur when the environment affects the trait more in some genotypes and less in other genotypes. GEI are considered as two types. One type of GEI is a crossover type, in which environmental effects cause a change in the rank of genotypes and in the magnitude (size) of the difference between genotypes. Non-crossover GEI’s occur when genotypic differences are larger in some environments than in others, but the genotypes show a similar rank across all the testing sites in which the trial is grown.

**For this exercise, you will receive an MS Excel file ‘ALA\_3 data across locations STUDENT version.xls’. This test was grown at 15 locations in a single year (2 replications/entry per location).**

**Tasks**

*Revised*

1. The data you have been given includes yield, height, and awns from a multilocational wheat trial.
   1. Identify which traits are qualitative and which are quantitative.
   2. Explain the difference between qualitative and quantitative traits.
2. Use Excel to create:
3. A histogram for yield,
4. and a vertical bar chart for the presence of awns. (Use Tab ‘Yield and Awn data’)
5. Create a separate histogram for yield for those genotypes with awns, and those without awns.
6. i) Does the presence of awns appear to be an environmentally stable trait?

ii) On what basis do you come to this conclusion?

1. i) Complete the columns for the genotype means and SD’s in the yield tab of the file.

ii) Do the same for the yield rank columns. [remember: that in real life, you would use a combined ANOVA to generate the overall mean across all locations – see Tab ‘Yield and Awn data’ which contains means generated from combined ANOVA].

1. Using the simple statistics calculated in #b above, critically assess the productivity and rank stability of the lines. Identify the best 5 yielding lines and the best 5 lines based on their stability.
2. How stable are the most productive (high yielding) lines?
3. How productive are the most stable lines?
4. Is there an instance where a high yielding line seems to be not stable?
5. What does this information tell you as a breeder?
6. Is the heritability of yield high, medium, or low? What information did you use in reaching your conclusion?
7. What do the CV’s tell you about the consistency of the genotype performance? (Use Tab ‘CV and Trial Info’)
8. From location 1, identify lines that were significantly higher yielding than Check1. [hint: look at LSD in Tab ‘Yield’]

[LSD = Least Significance Difference and if the absolute difference is greater than the LSD, two entries being compared are considered to be significantly different to each other for that trait]

3. a) What is the yield performance of the top 5 lines relative to the mean of the 5 checks?

b) Express the mean of each line as a % of the mean of the checks.

c) Does the mean of the top 5 lines exceed the mean of the checks?’

d) Express the mean of each line as a % of the mean of the checks

e) How is the information in 4a-4d helpful to you as a plant breeder?

4. a. Create a graph in Excel showing the performance of the Genotype7 and Genotype13 in locations 4 and 13.

b) Is G x E interaction present?

c) If present, which type of interaction is it?

d) On what do you base your conclusion about GEI related to these genotypes and locations?

5. Using the overall mean for height, identify the shortest and tallest (plant height) genotypes. (Use tab ‘Ht’; exclude checks)

6 . a) Plot these genotypes identified in #5 over locations 4 and 13.

b) Is G x E interaction present?

c) If present, which type of interaction is it?

d) On what do you base your conclusion about GEI related to these genotypes and locations?

7. a. Look at tab ‘Awn’. Is GEI present?

b. On what do you base your conclusion about GEI for awns?