Analysis of Genotype and Genotype By Environment Interaction in Louisiana Sugarcane Research Plots By GGE Biplots

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Introduction
- Sugarcane is cultivated/grown in 23 out of 64 Louisiana parishes in an area occupying 165756.8 hectares.
- The growing area includes two major soil types and other types of growing environments.
- Because the genotype by environment affects the yield of crops, it is necessary to evaluate cultivars in multiple environments for several years.
- The heritability adjusted GGE biplot or HA-GGE is able to graphically display genotype by environment interactions and identify the best cultivars for identified mega-environments and testing sites with the best discrimination and representation.

Materials and Methods
- Sugar per hectare yield data from 21 locations including 9 nursery and 12 outfield test locations (Figure 1) from four years (2012-2015) was analyzed using the GGE biplot software (Yan et al. 2010).
- Heritability adjusted biplots were created with the "where which won" option which discriminates the best genotypes for different locations and the discrimination vs. representation option which identifies location discrimination and representation (Figure 2) and the "mean vs. stability" option which compares the stability of genotypes to their yield.
- The numerical results from the biplots were summarized over years and locations or varieties using mixed model analysis.

Results
- The where which won plots did not identify consistent macro environments across crops or years (Figure 3).
- Comparisons of tester environment's representativeness showed significance in testers and crop by year interaction for both the nursery and outfield locations.
- The locations Glennwood, STG, and STO were the most representative and Magnolia and IRS the least (Figure 4).
- For the descriptiveness of locations, crop by year and year by tester interactions were significant in the nurseries but in the outfield only significant for tester.
- The locations St. Gabriel and St. John were the most descriptive and STO, Fred Martin, Magnolia, and Bonsecour were the least (Figure 4).
- There were no significant differences for instability in the nurseries but in the outfield, genotype was significant.
- The genotypes HoCP 00-950, L 03-371 were the least stable and L99-226 and L 01-283 were the most stable (Figure 5).
- Performance was significant among genotypes in the nursery and crop by genotype and year by genotype were significant in the outfield.
- The top performer most years was L 09-299 and the least performer most years was HoCP 96-540 or HoCP 07-613 (Figure 6).

Discussion and Conclusions
- No consistent macro environments were identified. This could indicate that the cultivars selected in this study were bred for general performance in any environment or are only selected for one macro-environment.
- Because there are differences in discrimination and representation among the locations tested, location utility could be ranked for breeding purposes. This could be made yearly in the nurseries where there was a year tester interaction.
- Cultivar utility could also be ranked according to stability and performance for use in evaluation.

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Reference