Evaluating Grain Yield Stability of Soybean (*Glycine max* (L.) Merr.) Genotypes using GGE Biplot Analysis across Three Environments in Zambia

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Introduction

Soybean (*Glycine max* (L.) Merrill) is a globally important legume crop, valued primarily for its high oil and protein composition, which are key determinants of its economic value.

Objective

The aim of this study was to identify high-yielding, stable soybean genotypes.

Materials and Methods

Seventy soybean genotypes, comprising fifty-nine elite IITA lines and eleven commercial checks, were evaluated in three locations: Chongwe, Kabwe and Mpongwe in Zambia (fig. 1) during the 2023/24 cropping season. The experimental design was a 10 x 7 Alpha Lattice Design with four replications. A cone plot planter (fig. 2) was used and the experimental plots measured 5 meters in length, consisting of two rows with an inter-row spacing of 0.75 meters and an intra-row spacing of 0.04 meters. Data were collected on grain yield, then adjusted to 13% moisture content. The yield data was subjected to Analysis of Variance (ANOVA) to test the effects of genotype, environment and their interaction. Genotype and Genotype by Environment (GGE) Biplot analysis was performed using R version 4.4.1 to visualize genotype performance, stability and the discriminating power of the test environments.

Fig 1. *Field evaluation of soybean genotypes*

Fig 2. *Planting using a plot planter*

Results

Results indicated significant variation in genotype response to environmental conditions. The highest yielding genotypes were TGx2014-49FZ, SC Signal and TGx2123-73FZ in Chongwe, Kabwe and Mpongwe, respectively (fig. 3a). When considering multi-environment performance, TGx2129-18FZ, SC Signal and TGx2014-49FZ emerged as overall high yielding genotypes (fig. 3b) with SC Signal exhibiting the greatest yield stability (fig. 3c), demonstrating adaptability across the experimental sites.

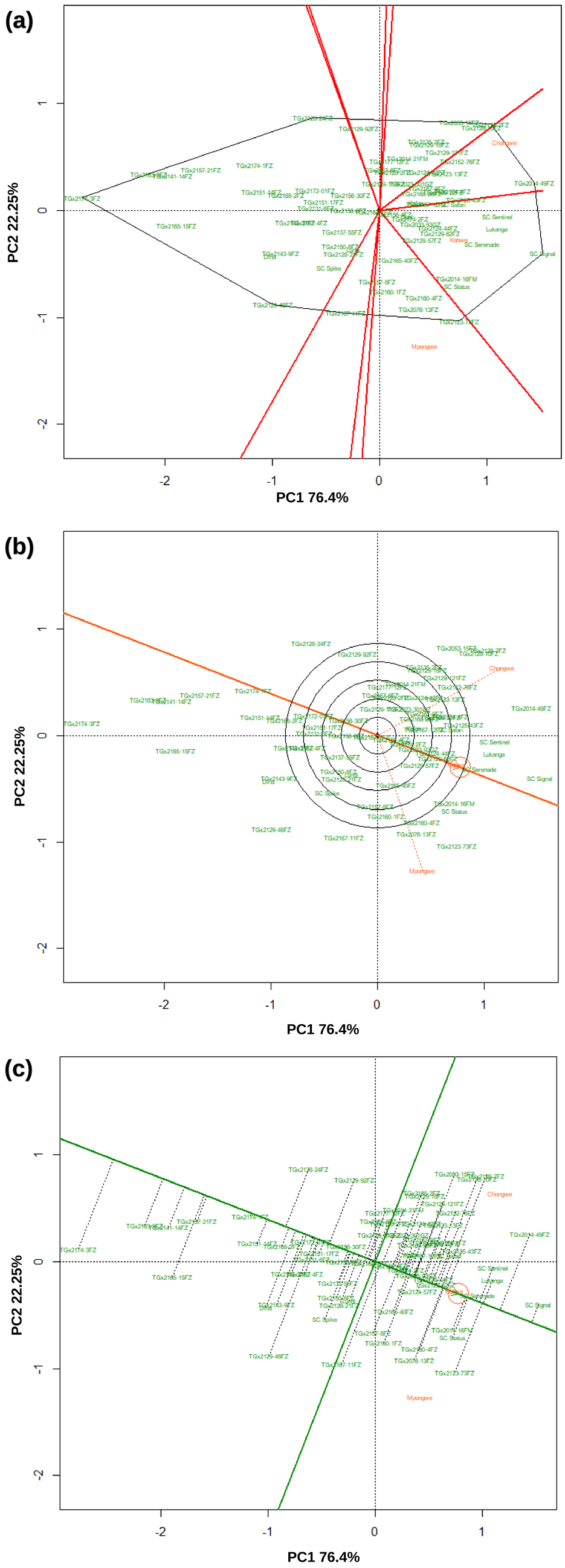

Fig 3. *GGE Biplot analysis showing: which-won-where" view of the GGE biplot of grain yield* ***(a)*** *the "discriminating power vs. representativeness" view of the GGE biplot* ***(b)***, *and the "mean vs. stability" view of the GGE biplot for identification of stable genotypes* ***(c)***.

Conclusion

The GGE biplot analysis effectively identified high-yielding and stable soybean genotypes adapted to both specific and broad environments in Zambia.