Assessment of finger millet cultivars/landraces for performance, stability, and interrelationships among traits under contrasting irrigation water-salinity levels in Dubai

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INTRODUCTION

Soil and water salinity are major contributors to decline in productivity of agricultural lands, thereby, limiting food and fodder production (Khan et al., 2006). The International Center for Biosaline Agriculture (ICBA) is presently exploring nutrient-dense and stress-tolerant under-utilized crops for dietary diversification in marginal environments. The objectives of this study were to identify finger millet cultivars with high grain and/or fodder yield(s), determine the stability of the cultivars and investigate interrelationships among traits under varying salinity levels.

METHODOLOGY

One hundred entries comprising 75 test cultivars (unreplicated) and 5 check cultivars which were replicated in each of five blocks using augmented randomized complete block design were tested under 0 (control), 6 and 10 dS/m irrigation water salinity levels at ICBA research field in 2021. Each experimental unit was 1 m^2 with inter- and intra-row spacings of 0.25m. Fertilization was done using NPK and urea. Weeds were controlled manually, while pesticide was used to control insects. Data were collected on days to maturity (DM), plant height (PHT), plant aspect (PASP), panicle weight (PWT), fresh fodder yield (FFYLD), dry fodder yield (DFYLD) and grain yield (GYLD). Measured traits were subjected to analysis of variance (ANOVA), correlation, path and stability analyses using appropriate statistical softwares (SPSS Inc, 2007; SAS Institute, 2011; PBTools, 2014).

RESULTS

Cultivars IE 2457, IE 3391, IE 4028, IE 7320, IE3392, IE 6337, IE 2619, IE 4646, IE 4797, and IE 6240 (Table not shown) were the top performers based on rank summation index (RSI) that incorporated high PWT, FFYLD, DFYLD and GYLD (Mulamba abd Mock,1978). The identified top performers for grain and fodder yields suggested the availability of cultivars for addressing the food and fodder deficits in the region.

Stability analysis revealed G5 (IE 3392) as highest yielding and most stable across all salinity levels (E1, E2 and E3), whreas G6 (E 6337) showed specific adaptation to E1 (0 dS/m) and G11 (IE7079) to both E2 and E3 (6 and 10 dS/m) salinity levels (Figs 1 and 2).

Cultivar IE 3392, with high grain yield and stability across all research environments could be cultivated under fresh and saline water irrigations environments. Similar findings were reported by Kandel et al (2020). Cultivar IE6337 with specific adaptation to 0 dS/m should be explored under freshwater irrigation while IE7079 with adaptation to 6 and 10 dS/m salinity levels should be promoted for production under saline water irrigation environments.

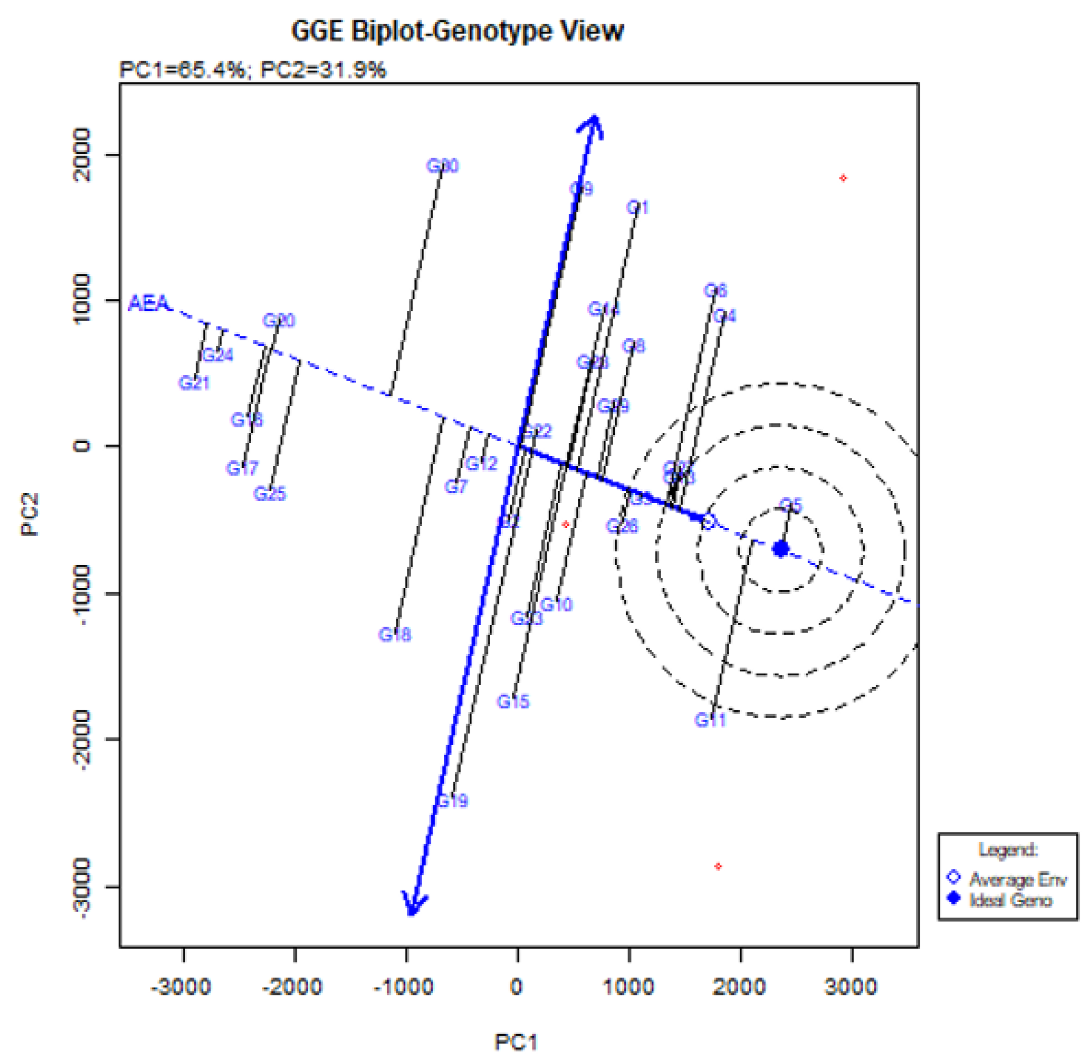


Fig 1. A Mean vs. Stability view based on a genotype x environment yield data of top 15, middle 5 and worst 10 finger millet cultivars under varying salinity levels, ICBA, Dubai.

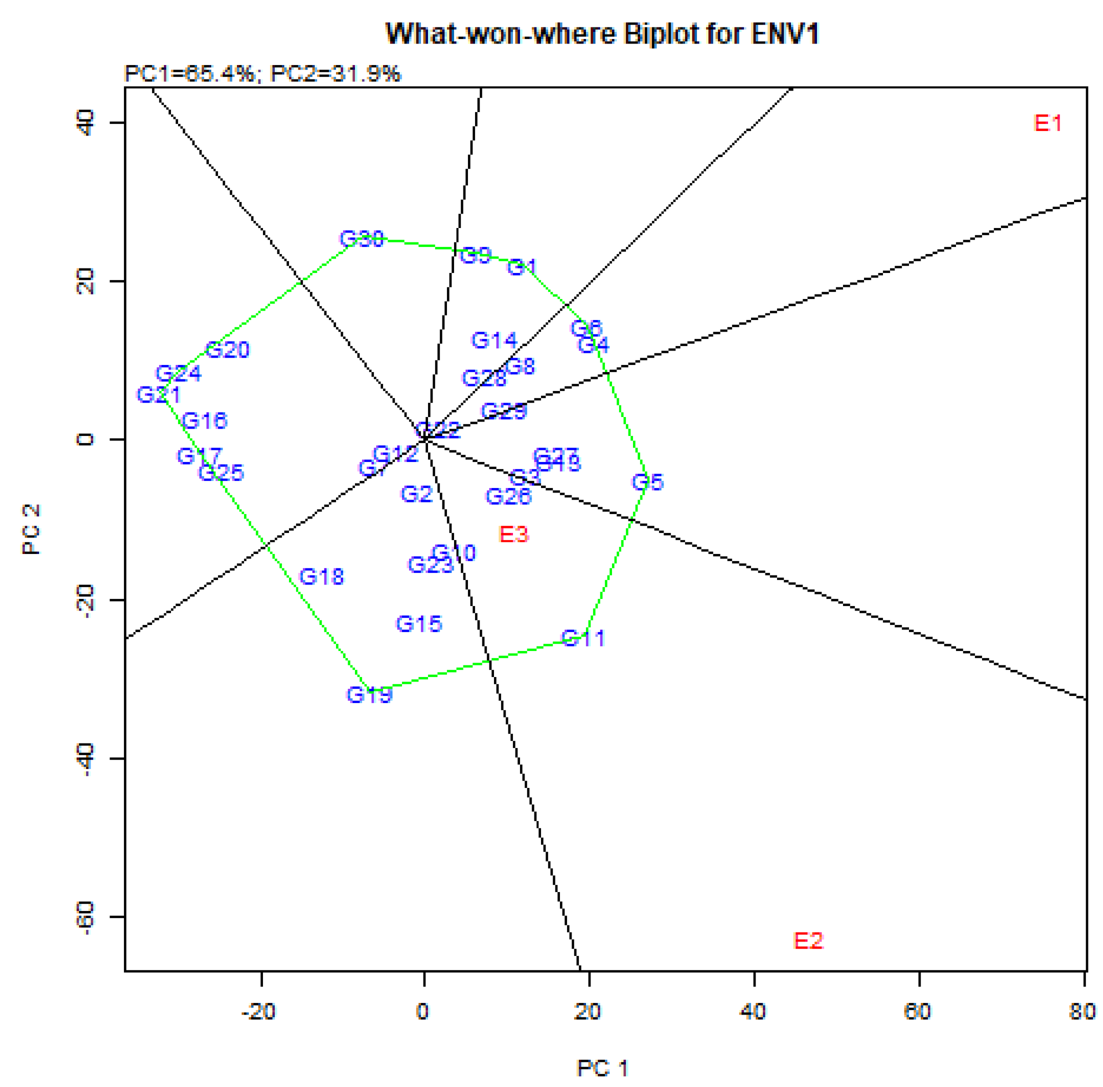
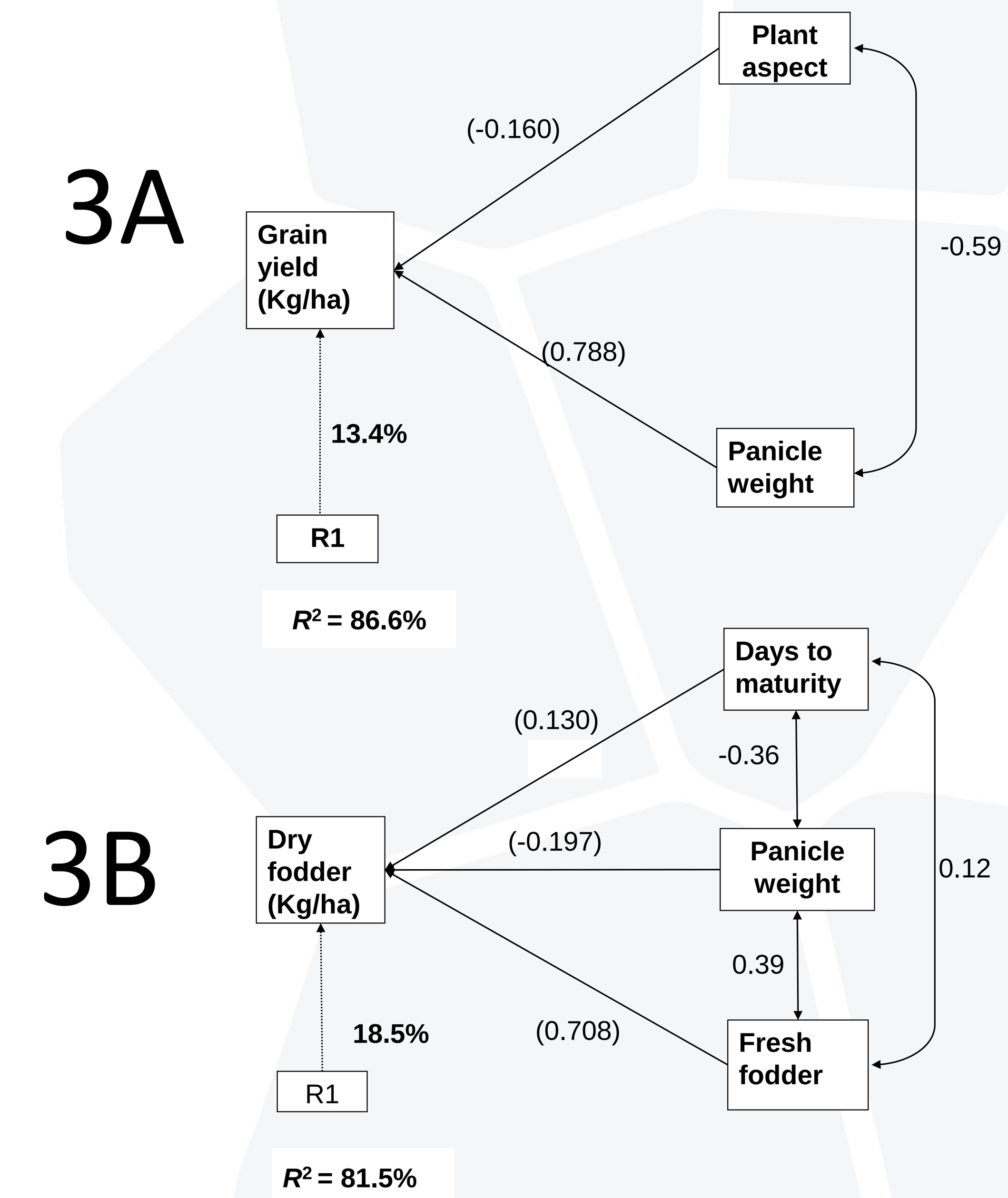


Fig 2. A Which-won where or which-is-best-at-what based on a genotype × environment yield data of top 15, middle 5 and worst 10 finger millet cultivars under varying salinity levels, ICBA, Dubai.

Path analysis revealed PASP and PWT as the traits accounting for 86.6 % of the variation in GYLD (Fig. 3A) while DM, PWT, and FFYLD were the traits identified as contributing 81.5 % to the differences in DFYLD (Fig. 3B). The PASP and PWT were the two important secondary traits for improvement of GYLD while DM, PWT, and FFYLD were found important for DFYLD improvement.



Figs 3A and 3B. Path diagrams showing grain and dry fodder yields of finger millet cultivars along with associated secondary traits under varying salinity levels, ICBA, Dubai. Values in parenthesis are direct path coefficients while other values are correlation coefficients. R1 is residual effect

CONCLUSIONS

The promising cultivars could contribute to the food and fodder requirements in salt-affected areas. Cultivar IE 3392 should be promoted for wide cultivation across all environments. However, IE 6337 should be explored for fresh irrigation water production while IE7079 should promoted for production under saline water irrigation environments. The PASP, PWT, DM, and FFYLD could serve as secondary traits for indirect or index selection for grain and/or fodder yield(s) improvement.

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