Sweetpotato Speedbreeders

# Validating Heterosis in Sweetpotato Breeding

## INTRODUCTION

Why developing hybrid breeding populations? Sweetpotato is a highly heterozygous clone hybrid crop and with hybrid breeding populations we achieve (i) yield increase, (ii) ease to stack simple inherited traits such as quality and disease resistance, and (iii) elevated yield stability. Achieving these goals is much more effective by offspring-parent analysis and heterosis exploitation than increasing current breeding efforts. Can current polycross breeding be the best for sweetpotato breeding? Hybrid breeding is different to polycross breeding with respect to the development of heterotic groups, controlled crosses, data managment, and intensive offspring – parent analysis.

**Fig 1.** Hybrid breeding populations (A) harvest of hybrid breeding population H0 in Peru (genepools PJ and PZ ) and (B) field trials for hybrid breeding population AxB in Mozambique (genepools A and B developed in Uganda).

## METHODS

**Study 1:** In total 231 families (210 cross combinations) comprising 6898 H0 hybrid genotypes were evaluated together with 49 PJ parents and 31 PZ parents at two locations (Huaral, San Ramon in Peru). Variance components due to families, genotypes within families, etc.; parent - offspring heterosis increments; variance components due to $GCA_{PJ}$, $GCA_{PZ}$, SCA, etc.; and GCA of parents were determined.
**Study 2:** In total 98 cross combinations (1010 genotypes) were evaluated under two treatments (irrigated, not irrigated) across two years (Umbeluzi / Mozambique). The parents were representing two genepools separated on basis of SSR markers designated Uganda A and Uganda B. The cross combinations were AxB (51 families, 609 genotypes), AxA (32 families, 264 genotypes), and BxB (15 families, 137 genotypes). Variance components due to families, genotypes within families, etc.; AxB versus AxA and BxB differences, variance components due to $GCA_A$, $GCA_B$, SCA, etc.; and GCA of parents were determined.
**Study 3:** In total 336 families comprising 3742 H1 NSSP clones were evaluated together with parents and the baseline (49 PJ parents and 31 PZ parents see study 1) at two locations (Canete, Satipo in Peru). Preliminary results from Canete for genetic gains for none-sweet after cooking are presented.

## RESULTS

**Study 1:** Yield increases by 18 to 20% in H0 OFSP early and widely adapted and selection of appropriate parents for H1 OFSP. **Study 2:** Storage root yield and biomass increases of about 10% and 20%, respectively, under drought stress and selection of appropriate parents for next breeding populations (e.g. Naspot 5 and African Resisto identified as parents with high GCA. **Study 3:** Variety ability in H1 NSSP was maintained despite extreme high selection intensities within genepools (5 PJ and 5 PZ out of 48 PJ and 31 PZ) and large genetic gains were obtained for low sugar (even no sweetness) after cooking.

Breeders will benefit by emphasizing parents that develop better offspring for various variety types. End users comprising farmers and consumers of various differentiation (household type, gender, age) will benefit by income generation due to extending sweetpotato in farming systems, more healthy food, new processing and market options.

## KEY TABLES OF RESULTS

**Table 1.** Average heterosis increments in OFSP PJ x OFSP PZ cross combinations (N=210) in H0 for observed traits evaluated at 2 locations in Peru.

| Variable | Heterosis increments PJ x PZ in HO as % Mean | P-Value | CL 95% limit of heterosis increments |
|---|---|---|---|
| Root yield | 18.5 | <0.001 | 15.0 – 22.0 |
| Com. Roots | 19.8 | <0.001 | 15.8 – 23.8 |
| Fol. Yield | -1.5 | 0.409 | -5.1 – 2.1 |

**Table 2.** Inter- and intra-pool cross means and differences for observed traits evaluated under 2 treatments (irrigation and no irrigation) across 2 years in Mozambique [families from Uganda, AxB (N = 51), AxA and BxB (N = 47)].

| Variable | Treat-ment | Interpool crosses AxB Mean | Intrapool crosses AxA & BxB Mean | Cross type difference in % | P-Value |
|---|---|---|---|---|---|
| Root yield | IRRI | 12.3 | 12.0 | 2.9 | 0.555 |
| t/ha | NOTIRRI | 7.3 | 6.6 | 11.2 | 0.103 |
| Fol. Yield | IRRI | 21.1 | 19.6 | 7.4 | <0.001 |
| t/ha | NOTIRRI | 21.0 | 17.3 | 21.2 | <0.001 |
| Biomass | IRRI | 33.4 | 31.5 | 5.8 | 0.006 |
| t/ha | NOTIRRI | 28.3 | 23.9 | 18.4 | <0.001 |

## RELEVANCE FOR DIFFERENT FOOD SYSTEMS

Diversification of food systems with sweetpotato, especially OFSP, via higher efficiency of breeding for OFSP under short growing seasons (90 days), for OFSP under drought prone areas, for none-sweet

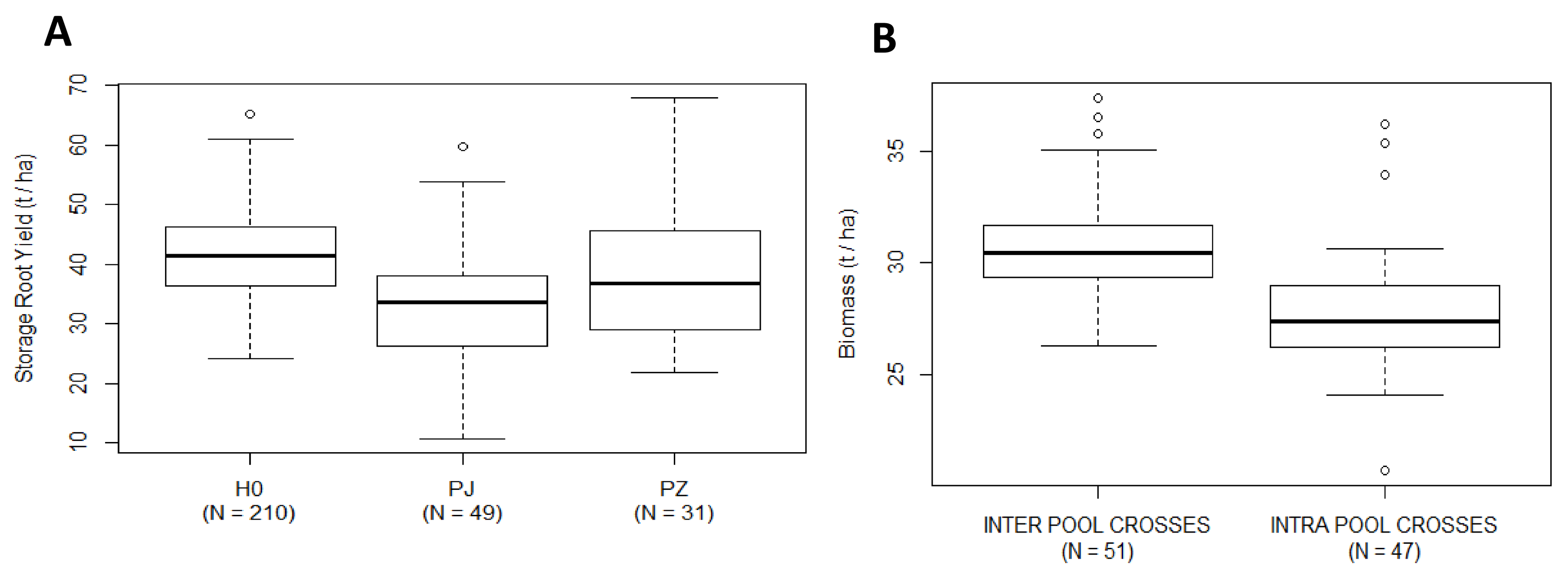


**Fig 2.** (A) Storage root yields for H0 cross combinations, PJ and PZ parents evaluated in Peru; (B) Biomass production for interpool crosses (AxB) and intrapool crosses (AxA and BxB) evaluated in Mozambique.

## CONCLUSIONS

The genepools PJ and PZ are mutually heterotic. There are strong indications that Uganda A and Uganda B are also mutually heterotic genepools (15 parents out of 150 parents tested). Superiority of hybrid breeding populations are more pronounced under stress conditions. Parents with high general combining ability (GCA) have been identified, which allows to choose appropriate testers for genepools. With testers the best parents can be chosen on basis of offspring information among a very large number of parents. Offspring information and GCA of parents is much more informative for the value of a parent than the performance of the parent *per se*. Through investments into genepool separation, controlled crossings and data management sweetpotato can be rapidly developed (short to medium terms, 5 years) into breeding populations with high variety ability for various needs and purposes.

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