

## ABSTRACT

Morpho-Physiological Selection Criteria Associated with Nitrogen Fixation and Yield in Pigeonpea (*Cajanus cajan* (L.) Millsp.)

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Pigeonpea (*Cajanus cajan* (L.) Millsp.) is a popular legume which is grown as a vegetable in the Caribbean region for its immature green seeds. Past breeding programmes at the University of the West Indies, have developed high yielding, dwarf, more determinate, short-duration varieties capable of year-round production. However the newly developed varieties had variable yields and inadequate biological nitrogen fixing (BNF) ability. Furthermore, hundred seed weight, seeds per pod as well as other physical and biochemical quality characteristics were inferior to the traditional varieties, thus affecting consumer acceptance. To overcome these challenges this investigation sought to assess (1) the inter-relationship between BNF, various morpho-physiological characteristics and yield and (2) the inter-relationship among yield, pod and seed quality characteristics. The study utilised 129 genotypes obtained from two independent pools of recombinant inbred lines (RILs). Through screening in low and high nitrogen soils, RILs were successfully classified into low, moderate and high responders to inorganic nitrogen, which represented good, medium and poor fixers, respectively. A subsequent  $^{15}\text{N}$  study found that, regardless of the grouping, at least 97 % of the nitrogen in the plant was derived from BNF, further indicating limited variation for this trait. In contrast there was a significantly ( $p < 0.05$ ) large genetic variability (13 – 48%) in BNF partitioning, measured as nitrogen harvest index (NHI), with good fixers having a greater pool of N for seed development. The study also showed that yield and quality traits can be simultaneously improved. New varieties that combine higher yields and better BNF ability with good consumer quality characteristics, have been developed. Screening at flowering for high biomass and limited photoperiod sensitivity, as well as post-flowering determinacy, good nodulation and pod number in low nitrogen soils, can be used as morpho-physiological selection criteria for improving nitrogen fixation partitioning and yield in pigeonpea breeding programmes.

Keywords: *Cajanus cajan*; pigeonpea; legume; recombinant inbred lines (RILs); morpho-physiological; selection criteria; nitrogen fixation; nodule;  $^{15}\text{N}$ ; yield; yield component; quality; correlation; biochemical; sink.