

Genetic diversity and recurrent multi-trait selection in a Navy Bean breeding program

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Introduction and Methods

With the expansion of Navy bean breeding into a major project in 1982, the immediate strategy was a broadening of the genetic base of the existing breeding program by infusion of new introductions (from USA, Canada, CIAT) after evaluation. The aims were increased grain yield, increased bush and pod height to allow direct harvesting, disease resistance for rust, common bacterial blight, and peanut mottle virus, and acceptable canning quality. The breeding program entailed artificial hybridisation in winter, a spring F_1 generation and F_2 and F_3 (self-pollinated) generations in the following summer and spring seasons, with mass selection for rust and common blight. Then in a F_4 summer nursery, single plants were selected for disease resistance, erect habit and pod set. From 1985 F_5 seed was sub-sampled for an over-winter screening in the glasshouse for peanut mottle virus resistance. From a field evaluation of F_5 lines for agronomic potential and disease resistance, entries were selected for F_6 preliminary trials, followed by advanced and then regional trials in successive years, leading to release of new varieties. Thus 5 early generations were achieved in 2½ years prior to annual yield trials. The preliminary trials were not assessed for canning quality until 1988, previously only the regional trial entries had been evaluated. The first preliminary trials were mainly derived from crosses between local and introduced selections (Fig 1).

A non-structured recurrent selection using outstanding derived recombinants as parents contributed to trials from 1988 onwards. However for the 1991 (not evaluated until 1992) and 1992 trials, the proportion of non-derivatives was increased by a further broadening of the gene pool. Although 357 crosses had been made by 1988, only 192 actually contributed to preliminary trials (up to 1992). From 1989 there was a second preliminary trial comprised of both virus susceptible entries and the previous years selections for which F_6 seed supply was inadequate.

Discussion

The yields of preliminary trials, though affected by annual influences have remained above the Actolac check since 1987 (Fig. 2). Regional trial yield trends tended to have entries from preliminary trials two years earlier, and mirrored the yield trends of the latter. Lateness has been slowly reduced since 1987, virus resistance has increased, lodging has been reduced although it rose markedly in 1989 in conjunction with new germplasm infusion and gains in canopy height, and canning quality has dramatically increased (Fig. 4). Pod height, other disease resistances, and vinyess have remained steady. The net affect has been uneven progress with selection gains in 1-2 traits while levels of other desired traits has remained steady. These analyses are strongly influenced by genotype x year interactions with the sole check variety Actolac, with an association between the mean and level of selection response from 1987 onwards. Although only first cycle recombinant derivatives have contributed selections, F_1 crosses between

derivatives gave entries to 1991 and 1992 trials, and second cycle recombinants will become important for future trials. A balance is required between continual infusion of new germplasm, and incremental gains with recurrent selection which has a penalty of gene pool contraction.

Figure 1

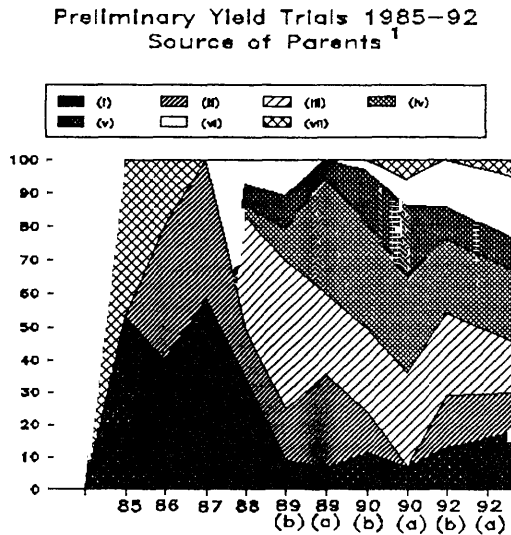


Figure 2

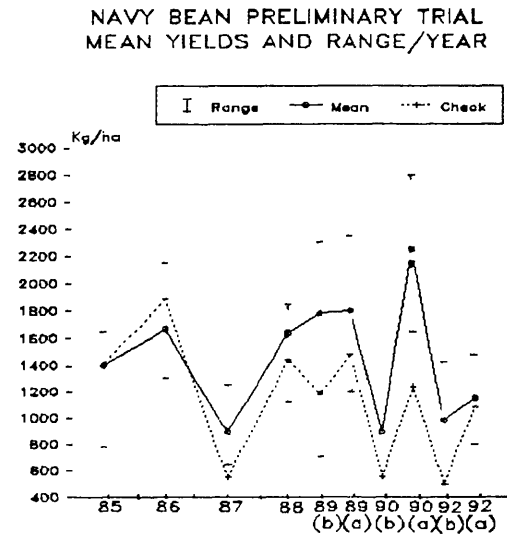


Figure 3

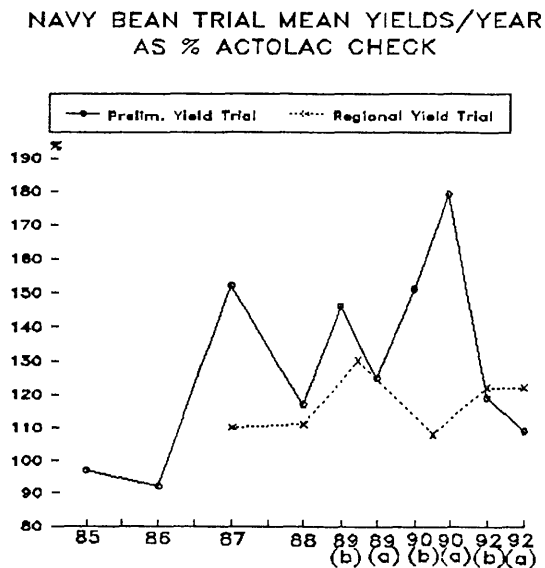
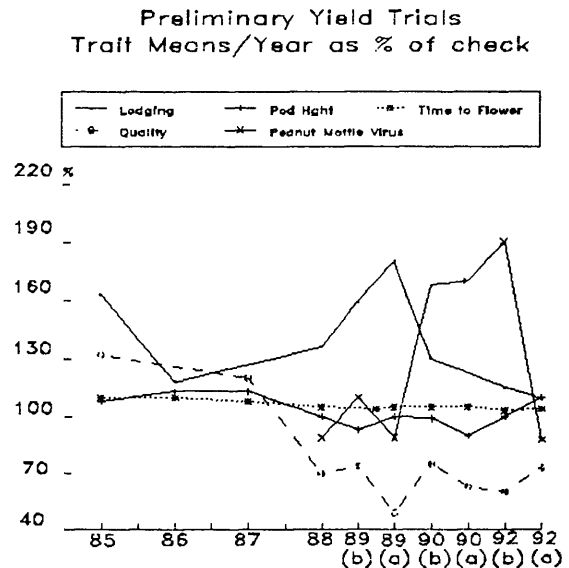


Figure 4



¹ Source of parents:

- (i) introduction x local selection (old QDPI program)
- (ii) introduction x Introduction
- (iii) derivative selection x derivative
- (iv) introduction x derivative
- (v) local x derivative
- (vi) crosses of F1's with local, introduced and derivative selections
- (vii) local x local