

ABSTRACT

In a bean breeding program recently developed for Jamaica, 115 bean lines developed in Puerto Rico by crossing two Jamaican red kidney bean landrace varieties "Miss Kelly" and "Portland Red" with disease resistant bean breeding lines, were evaluated in Jamaica using classical agronomic tools. Seventeen of the most promising lines were selected for detailed analysis using molecular biology and agronomic tools of which two lines (8954-9 and 9158-75) were chosen as likely commercial cultivars, and three lines (9158-75, 9172-43 and 9158-83) were selected for use in future breeding programs. The new bean lines were evaluated to identify genetic markers for disease resistance, yield potential and enhanced biological nitrogen fixation. The new lines were characterized genetically using molecular markers such as phaseolin proteins, random amplified polymorphic DNA (RAPD) and restriction fragment length polymorphism (RFLP). Genetic markers were correlated with morphological, agronomic and adaptation traits. Analysis of the lines for seed protein variability using one dimensional SDS-PAGE showed patterns previously described among bean types. These include S (Sanilac) and T (Tendergreen) as well as a banding pattern recently described among cultivated beans called the M (Middle American) phaseolin. RAPD's proved useful as a molecular

marker and showed numerous polymorphisms among the new lines as well as in the parental types indicating high genetic diversity within the bean lines. RAPD analysis showed DNA fragments which appear to be typical of the new bean lines and the local cultivar Miss Kelly. Calculated average genetic distances was used to show the genetic relatedness of the new bean lines to the parental types. RFLP revealed greater polymorphism among the lines when compared to RAPD. RFLP showed the presence of four major DNA bands which hybridized to an rDNA probe and was typical of all the bean lines analyzed. RFLP indicated heterogeneity at specific loci in the new bean lines which may be linked to the phaseolin types.

Total seed protein analysis showed that the protein content of the new bean lines ranged from 17% to 30%. The highest protein content was found in the line 9158-75. Protein content of the local cultivars ranged from 17% to 26%. Phosphorous values were low in all the new lines.

Nitrogen fixation studies with the bean lines along with the local parental types, were carried out in non-sterile soils obtained from three different locations with rhizobia inoculants containing the strains B17 and CIAT 652. Plants produced the greatest biomass and nodule numbers in soils from Top Mountain (St. Andrew) and the lowest biomass and nodule numbers were produced in soils from Robins Hall (Manchester). Bean lines

8954-9 and 9158-75 produced the most effective associations with these strains. Line 8954-9 also gave the highest shoot phosphorous values in all soil types tested.

The new bean lines along with local parental cultivars were evaluated in the field at five different locations including the Department of Botany, University of the West Indies, St. Andrew, Robins Hall, Manchester, Bushy Park, St. Catherine, Caribbean Agricultural Research and Development Institute (CARDI), in St. Andrew, and Goshen in St. Mary over a 3 year period. Lines were evaluated for disease resistance, biological nitrogen fixation, and variation of traits related to yield.

Tolerance to BGMV, CBB, WB and rust were determined for the new lines and the local parental types. The incidence of bean golden mosaic virus (BGMV) ranged from 0 to 9% with the greatest incidence being recorded at Goshen. The most tolerant lines were 9158-75 and 8954-5. Common bacterial blight was present mainly at Bushy Park and the incidence ranged from 0% to 45%. Web blight was prevalent at both Bushy Park and Robins Hall with incidence ranging from 0% to 43%. Line 9158-83 was very tolerant to both CBB and WB. The highest rust incidence was observed at Goshen. Line 8954-5 was rust sensitive with an incidence of 37.4%. Miss Kelly, on the other hand, was rust resistant.

Days to flower, days of pod fill and days to maturity ranged from 29 to 43 days, 25 to 45 days and 50 to 72 days respectively. Seed yield and biomass ranged from 0.5 to 140 g/m row and 62 to 240 g/m row respectively with the highest yields being recorded at Robins Hall. The harvest index (HI) ranged from 0% to 69.5% with line 8954-9, 8954-5, 9158-75 and Miss Kelly giving harvest index values in the optimum range for all trials. This parameter gave a positive kurtotic value for all the trials and as such was primarily used for line selection. The biomass and seed growth rates ranged from 1.0 to 4.9 gm⁻¹day⁻¹ and 0 to 4.3 gm⁻¹day⁻¹ respectively. The economic growth rate extended from 0 to 1.9 gm⁻¹day⁻¹.

Overall phaseolin, RAPD and RFLP markers all gave specific fingerprints for the different bean lines. Greater variations were observed with the DNA based markers as compared to the protein markers. Agronomically, 8954-9 and 9158-75 appear to be the lines most favourable for commercialization as they gave good yield potential and harvest index values comparable to the local cultivars Miss Kelly and Portland Red. They were tolerant to diseases and had increased biological nitrogen fixation ability which is essential for commercialization.