B-21: A Dry Black Bean Breeding Line with Multiple Virus Resistance

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In North America, dry black beans are produced primarily for the domestic and Latin American export markets. Currently, most black bean cultivars are susceptible to a broad array of viral diseases that are causing serious crop losses in the western hemisphere. Black Turtle-1 (‘BT-1’), a selection out of ‘Black Turtle Soup’, has resistance to five viruses, but is extremely susceptible to bean yellow mosaic virus (BYMV) (Provendi, 1983). BYMV is one of the most destructive viruses, but is extremely susceptible to bean yellow mosaic virus (BYMV) (Provendi, 1983). The primary purpose of this breeding program was to incorporate BYMV resistance into ‘BT-1’. Because ‘BT-1’ has a partially recumbent growth habit, which is horticulturally undesirable, a second objective was to select for a plant type similar to the standard ‘Black Turtle Soup’ (‘T-39’) or ‘Midnight’ (Sandsted, 1980).

Origin

The backcross method was used to develop B-21. The recurrent parent ‘BT-1’ carried resistance to: a) bean common mosaic virus (BCMV) (pathotype groups I, II, IVa, V, and VII), conferred by the I gene, without any of the recessive genes (Provendi et al., 1984); b) blackeye cowpea mosaic virus (BICMV) (Provendi, 1987), conferred by the dominant gene Bcm (Provendi, 1987); c) cowpea aphid-borne mosaic virus (CAbMV), governed by the dominant Cam gene (Provendi, 1987); d) watermelon mosaic virus-2 (WMV-2), conditioned by the dominant Hsw gene (Provendi, 1987); and e) tobacco mosaic virus (TMV) conditioned by the dominant Tm gene for necrotic hypersensitivity (Provendi, 1987). Recent work has suggested that the I, Bcm, Cam, and Hsw genes are tightly linked or perhaps pleiotropic (Kyle and Dickson, 1987). The donor parent was ‘BL-6’, a breeding line possessing the single dominant By-2 gene for resistance to BYMV. ‘BL-6’ was derived from an interspecific cross between a scarlet runner bean (P. coccineus L.) and a pole ‘Blue Lake’ (Dickson and Natti, 1968).

Breeding line ‘BT-1’ was the female parent for seven generations and ‘BL-6’ was the male parent in the initial cross. In each backcross generation (BC-1→BC-6), a minimum of 16 plants was mechanically inoculated at the primary leaf stage with a known strain of BYMV to locate progeny with the By-2/+ genotype. Resistant plants from the BC-6 generation were selfed (BC-6F2) and inoculated with BYMV. Resistant BC-6F2 plants were selfed to produce BC-6F3 sub-families, and a minimum of 16 plants from each sub-family was progeny tested to confirm homozygous resistance (By-2/By-2). In each generation, selection was practiced to recover the black seed type and obtain an upright growth habit. Seed derived from BICMV-resistant BC-6F3 plants were then tested with BCMV, BICMV, CAbMV, WMV-2, and TMV to confirm resistance to these viruses. Breeding line B-21 was derived from the BC-6F3 generation.

Description

B-21 is an upright plant, 40 to 60 cm in height, often shorter than the cultivar Midnight, which has the same height range, but is taller than ‘T-39’, which is 30 to 40 cm. Plants are stiff-stemmed, with an indeterminate growth habit (CIAT Type 2), and 10- to 15-cm terminal runners that tend to intertwine. Like ‘Midnight’, B-21 has 12 to 16 mainstem nodes, compared with 10 to 14 for ‘T-39’. On average, B-21 matures in 104 to 108 days, whereas ‘Midnight’ and ‘T-39’ mature in 98 to 104 and 99 to 102 days, respectively. Flowers are purple and produce pods 6 to 9 cm long with five to seven seeds. Mature dry pods are a tan and the seeds dull black. The 100-seed weight ranges from 20 to 23 g. ‘Midnight’ and ‘T-39’ have similar seed characteristics, but 100-seed weights are 19 to 22 and 18 to 21 g, respectively.

Biomass and seed yield of B-21 were compared to ‘Midnight’ and ‘T-39’ at the Cornell Research Farm in Freeville, N.Y. (Table 1). B-21 was not significantly different from ‘Midnight’ or ‘T-39’ in either biomass or seed yield (Table 1). These data suggest that B-21 is comparable to standard dry black bean cultivars and may be suitable for final evaluation and release as a new virus-resistant cultivar.

Availability

Small quantities of seed are freely available to all. Contact D.H.W.

Literature Cited


Table 1. Biomass and seed yield of B-21 ‘T-39’ and ‘Midnight’ grown at Freeville, N.Y.

<table>
<thead>
<tr>
<th>Line</th>
<th>Mean seed yield (g/plant)</th>
<th>t statistic</th>
<th>Mean biomass (g/plant)</th>
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<tr>
<td>B-21</td>
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<td></td>
<td>2397.3</td>
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