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Interaction of Genetic Resistance to Fusarium Root Rot with Cultural Practices in a White-Seeded Bush Snap Bean

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For many years effective resistance in Phaseolus vulgaris to Fusarium root rot caused by Fusarium solani (Mart.) Appel. & Wr. f. sp. phaseoli (Burk.) Snyd. & Hans. was only associated with "wild" characteristics, such as small dark seed, a fibrous pod, late maturity, and a vine habit. Resistance was reported to be multigenic and of low heritability.

Over the years various cultural practices were developed which reduce the severity of root rot damage in susceptible cvs. Deep subsoiling which breaks through the "plow pan" allows roots to penetrate into the second and third foot of soil, where additional moisture and nutrients are available. Overwatering, especially when plants are young, may injure or kill small roots by oxygen starvation. Injured roots leach nutrients, which stimulates soil pathogens; thus aggravating the problem. Judicious water application reduces root rot damage. Also equidistant spacing (closer rows and seed spread further within the rows) reduces interplant competition and increases unit area yields. A summary of the interactions of these cultural practices on the severity of root rot damage in a susceptible cv. Blue Mountain was reported by Silbernagel and Mills in the 1984 BIC 27:131-132.

This year the same field study was repeated with 'Blue Mountain'; except for the addition of a Fusarium-resistant breeding line, FR-264. FR-264 is a sister line of the germplasm line FR-266 being released in 1985 (release notice this issue). The treatments were the same as in 1984, i.e. 11" row spacing at 4 seed/linear foot of row vs. 22" rows at 8 seed/ft of row; deep subsoiling (18-20") between rows vs. no subsoiling in a uniformly compacted field; and differential sprinkler irrigation from bloom to harvest to refill the soil profile when available soil moisture had reached 50% vs. 60%.

Data were collected on emergence, hypocotyl root rot damage, and dry plant weights at bloom time (before differential irrigation treatments were begun). Results are summarized by cultivar in Table 1.

Table 1. Effects of row spacing and tillage on bean cv. emergence, root rot disease index, and dry plant weights

Treatments[1]		Blue Mountain			FR-264			Means		
Row Spacing	Tillage	% Emerg	Root Rot[2] Rating	Dry Plant wt gms	% Emerg	Root Rot Rating	Dry Plant wt gms	% Emerg	Root Rot Rating	Dry Plant wt gms
11	DS	87.9	75.3	54.0	75.7	63.2	69.5	81.8	69.3	61.2
22	DS	89.7	71.9	47.6	72.4	63.0	58.7	81.1	67.4	53.1
11	NS	92.0	70.4	38.4	86.4	63.0	47.3	89.1	66.7	42.9
22	NS	87.8	68.6	43.0	71.3	62.7	46.1	79.6	65.7	44.6
Means		89.4	71.5	45.8	76.4	63.0	55.4	82.9	67.3	50.4

[1] Row spacing = 11" (4 seed/ft) vs. 22" (8 seed/ft), Tillage = deep subsoiling (DS to 18-20") between rows vs. no subsoiling (NS). [2] Root rot rating 0-100(dead).

Emergence was about 13% better with 'Blue Mountain' than FR-264. The only treatment that seemed to influence emergence was 11" row spacing over 22" row spacing, especially in FR-264 (81% vs 72%).

FR-264 had a consistently lower disease index than 'Blue Mountain'. This may have been slightly influenced by the lower population density, but is probably an accurate reflection of its higher level of root rot resistance, since it is consistent with greenhouse results.

Dry plant weights were significantly increased by deep subsoiling in both cvs. However, the detrimental effect of not subsoiling was more severe on the susceptible cv. (as would be expected) than on the resistant FR-264.

Seed yields are summarized in Table 2. Cultivar differences were very striking, with FR-264 essentially producing twice (3340 lbs/A) the seed yield of 'Blue Mountain' (1699 lbs/A) under the best of conditions; and almost three times 'Blue Mountain' under the severest root rot conditions (1801 vs. 624 lbs/A, respectively).

Table 2. Effects of differential row spacing, tillage, and available soil moisture on bean cv. seed yields (lbs/A)

Treatments[1/]				
Row sp.	Tillage	ASM	Blue Mountain	FR-264
11	DS	50	1699	3340
		60	1310	2501
22	DS	50	1417	2753
		60	1468	2422
11	NS	50	955	2380
		60	421	2462
22	NS	50	852	1928
		60	624	1801

[1/] Row spacing and tillage same as Table 1. Irrigation when available soil moisture content = 50% vs. 60% between bloom and harvest.

Tillage had the next-greatest influence on seed production, with deep subsoiling increasing overall mean yields almost 700 lbs/A over non-subsoiled treatments. Soil moisture replacement at 50% ASM produced a net gain of about 300 lbs/A over 60% ASM. Row spacing had the least overall effect, with 11" spacing not showing any significant difference over 22" spacing.

While both cvs responded similarly to the differential cultural practice treatments in terms of magnitude, the percent gain (not shown) was usually two to three times greater for 'Blue Mountain' than for FR-264; a remarkable demonstration of the value of the genetic resistance of FR-264. Even under the worst field conditions, FR-264 did as well (1801 lbs/A) as 'Blue Mountain' under the best conditions (1699 lbs/A).