Dry Bean Root Rot: Variety Resistance and Molecular Diagnostics

Fusarium cuneirostrum was identified for the first time in Canada as part of the dry bean root rot complex. Dry bean varieties were identified with partial resistance to root rot, which will help with the development of resistant varieties in the future.

ROOT ROT DISEASES are considered a serious threat to dry bean production. Past surveys have shown that bean root rot is caused by a complex of pathogens, including as many as seven fungal species. The most prevalent species in Manitoba have been *Rhizoctonia solani* and *Fusarium solani*, but other *Fusarium* species require further investigation. The first step of root rot investigation is identifying the species involved and monitoring their changing populations over time. Refinement of molecular diagnostics will make rapid, specific and sensitive detection possible.

When it comes to root rot control, resistance is not a common trait of most dry bean varieties in Manitoba, but a few have previously shown partial resistance to several *Fusarium* species and *R. solani*. This research aimed to provide new information for the future adaptation of root rot resistance in bean varieties.

Two complementary studies were conducted. The first involved annual dry bean disease surveys from 2013–2017, in which 30 bean plants were collected from each of 40 fields in Manitoba to be rated visually for root rot severity and 15 plants were further evaluated in the lab. Symptomatic bean roots were used for molecular diagnostic testing. The second study evaluated 36 dry bean varieties for their reactions to four different root pathogens, including three different *Fusarium* species and *R. solani*. Field trials were conducted at Morden. The inoculum of a specific root rot pathogen was added to the seed of each variety just before planting.

In the first study, average root rot severity was greater in 2013–2017 compared to the previous five-year period. Fusarium root rot was detected in all bean fields that were sampled. According to in-depth root pathogen identification, up to 12 different *Fusarium* species were identified.

Table 1. Seedling emergence and root rot ratings for a subset of 10 commercial dry bean varieties tested (of 36 total) against root pathogens, compared to the mean of control varieties in the root rot resistance experiments.

Variety	Market Class	Emergence (%)	Disease Severity Rating (0–9)
Windbreaker	Pinto	57	5.2
CDC Pintium	Pinto	54	5.1
Etna	Cranberry	56	**3.4**
Beryl	Great Northern	58	5.1
CDC Jet	Black	**62**	**4.7**
AC Redbond	Small Red	**64**	5.1
Early Rose	Pink	**72**	5.3
Pink Panther	Light Red Kidney	**65**	5.1
T9903	Navy	52	4.9
Arikara Yellow	Yellow	**70**	4.8
Mean of Control Varieties		57	4.9
LSD (n = 40,1080; 443 df)		5	0.25

Bold = better than the mean of all the controls based on least significant differences (LSD) at 5%; underlined = worse.

Fusarium cuneirostrum was identified as a causal agent of root rot in dry beans for the first time in Canada. A set of *Fusarium* species were screened for pathogenicity on the variety, Envoy. Of the species tested, *F. cuneirostrum* was the most aggressive, followed by two isolates of *F. avenaceum*. Other *Fusarium* species were less aggressive, but they could still impact dry bean productivity as part of the root rot complex due to their abundance.

In the second study, several varieties with partial resistance to seedling blight were identified by their high rates of seedling emergence, including CDC Jet and Pink Panther (Table 1), among others not listed.

Most varieties consistently had high root rot severity ratings, but a few showed partial resistance to root rot, as indicated by their low root rot ratings in Table 1. The partially resistant check, Etna, showed resistance to all of the pathogens at both locations. Another cranberry bean, Cran 09, and another black bean, Black Violet, were also partially resistant to root rot (data not shown). Root rot resistance rarely occurs in large-seeded market classes, so its detection in the cranberry bean varieties was an important finding.

Rhizoctonia solani inoculation resulted in the lowest seedling emergence (60%, on average) compared to other pathogens (67% for the *Fusarium* species). Root rot severity was greatest in plots inoculated with *Fusarium* species (4.8, on a scale of 0–9) and *R. solani* (4.4).

These results have since informed dry bean breeders of suitable root rot resistant parents for crossing programs. They have helped make important strides in molecular diagnostics, including new detection techniques for root pathogens for faster and more precise management decisions in the future.

This study was not intended to evaluate or endorse any dry bean variety for its suitability in Canada. AAFC expressly disclaims any implied warranty of merchantability, non-infringement or fitness for a particular purpose concerning the research findings.

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MPSG INVESTMENT $45,000 (Study 1), $60,000 (Study 2)

DURATION 5 years