

Evaluation of the anthracnose reactions in dry beans in the Coop trials.

R.L. Conner, A. Hou and P.M. Balasubramanian.

Introduction and Literature Review

Anthrachnose, caused by the fungus *Colletotrichum lindemuthianum*, poses a major constraint on the production of dry bean in Manitoba and Ontario. Anthracnose develops early in the growing season and produces brown to black lesions along the veins of the lower leaves. Rain spreads the spores of *C. lindemuthianum* to neighboring plants and further up into the canopy onto the stems and pods, resulting in the formation of brown to black sunken lesions (Pastor-Corrales and Tu 1989; Tu 1981). Pod infection results in the formation of brown lesions on the seed. A high incidence of seed discoloration greatly reduces the value of the seed. Seed infection also results in reduced germination rates, poor seedling vigor and seedling death (Mohammed et al. 2005, 2007). Anthracnose outbreaks severely diminish crop yields (Schwartz et al. 2005). A recent two-year multi-location study in Manitoba demonstrated that a seed-borne infection rate of 7% of the viable seed of the navy bean cultivar Navigator resulted in yield losses ranging from 15% to 32% (Conner et al. 2004).

Anthrachnose can best be controlled through the improvement of disease resistance in new cultivars. At least six races of anthracnose have been identified in Ontario and/or Manitoba (Conner et al. 2005) and currently race 73 is the most widespread. A major limitation for developing dry bean cultivars with durable anthracnose resistance is the magnitude of variability in *C. lindemuthianum* (Kelly et al. 2003). Multigenic resistance is needed to provide long-term control of this disease. Dry bean lines with *Co-1* and *Co-4* genes are resistant to all anthracnose races present in Canada (Dongfang et al. 2007, 2008). Previous research has determined that anthracnose resistance is rare or completely absent in certain bean classes such as small red and pink beans (Dongfang et al. 2008). Many of the bean cultivars grown in Manitoba are susceptible to the prevalent anthracnose races, but remain popular because of their high yield potential and good seed quality (Dongfang et al. 2007, 2008).

Objectives

Evaluate dry bean coop entries for their seedling reactions to anthracnose races.

Methodology

Controlled environmental studies were conducted to evaluate seedling resistance in first and second year entries from four dry bean Cooperative Registration Trials against two anthracnose races (race 73 and 105). The entries from a specific cooperative registration trial were tested in groups of 15 to 30 entries along with resistant and susceptible check cultivars. The entries in each test were replicated three times and the tests for each race were repeated at least once. The results of these tests were reported at the annual meetings of the Prairie Recommending Committee Pulse and Special Crops (PRCPSC) of the Prairie Grain Development Committee (PGDC).

Results

In 2010, 2011 and 2012, 115, 96 and 90 entries, respectively, from three Cooperative Registration Trials on the Canadian prairies, including the Short Season Wide Row Irrigated Dry Bean Coop (AB), the Short Season Narrow Row Dry Bean Coop (SK) and Long Season Wide Row Dry Bean Coop (MB) trials, were evaluated for seedling resistance to anthracnose. There was no Long Season Narrow Row Dry Bean Coop (MB) trial in 2011 or 2012. Seedlings were grown in growth cabinets and were separately inoculated and evaluated for resistance to anthracnose races 73 and 105. Out of all the candidate dry bean cultivars that were evaluated, 14, 9 and 25 were resistant to race 73 in 2010, 2011 and 2012, respectively. A total of 10, 8 and 23 coop entries were resistant to race 105 in 2010, 2011 and 2012, respectively. The number of candidate dry bean cultivars that were resistant to both races was 10, 8 and 23 in 2010, 2011 and 2012, respectively. One candidate cultivar had intermediate anthracnose reaction to both races in

2011. The screening results were reported to the PRCPSC of the PGDC in February of the following year.

Discussion

In 2010, 2011 and 2012, the results of experiments to evaluate 115, 96 and 90 bean coop entries, respectively, for seedling resistance to anthracnose were reported at the annual meeting of the PRCPSC of PGDC. Information from these experiments showed that the second-year small red bean entry SR 47-3-3 and the great northern entry GN13-1-1 and L08GN743 had susceptible ratings to both anthracnose races, which were similar to their respective check cultivars. The navy bean entry NA06-002 and the pinto bean entry L09PT129 were both shown to be resistant to races 73 and 105. The information on the disease reactions of SR 47-3-3, GN13-1-1 L08GN743, NA06-002 and L09PT129 was used to support the registration of these candidate cultivars. Similar research characterized the anthracnose reactions of the newly registered navy bean cultivar Portage, black bean Carman Black and the great northern bean AAC Tundra as anthracnose susceptible and this information was included in their cultivar descriptions (3 scientific publications). This research was described in seven technology transfer articles and in a conference proceeding.

Lessons Learned and Next Steps

As initially proposed, entries from the breeding programs of government institutions and private companies in the dry bean coop trials for western Canada were assessed for their seedling reactions to two races of anthracnose. This information was considered in the assessment of the suitability of candidate cultivars as new commercial dry bean cultivars. Improvements in anthracnose resistance in new commercial dry bean cultivars will result in a general reduction in the adverse impacts of this disease. In AAFC, breeding for anthracnose resistance has been underway for less than 10 years, so in 2012 it was gratifying to see an increase in the overall percentage of anthracnose resistant dry bean coop entries. Information from this study was used to support the registration of eight candidate cultivars of dry beans from AAFC breeding programs and was included in three cultivar descriptions. A research proposal entitled "Dry bean improvement for sustainable production in Canada" was submitted for consideration as part of Growing Forward II and this proposal included further research on the evaluation of entries in the dry bean coop trials and advanced breeding lines for their reactions to anthracnose races. Continued evaluation of advanced breeding lines and coop entries for anthracnose resistance is needed to ensure further progress in the genetic control of this disease and to provide this information to growers to assist them in the selection of the most appropriate cultivars for their farm operations.

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