PROGRESS REPORT ON PROJECT TITLED

"INTEGRATED MANAGEMENT OF FUSARIUM CROWN ROT AND TAKE-ALL OF WHEAT AND BARLEY IN CONSERVATION TILLAGE SYSTEMS IN THE WESTERN CAPE PROVINCE"

1. Project details

Number:	I11607
Title:	Integrated management of Fusarium crown rot and take-all of wheat and barley in conservation tillage systems in the Western Cape Province.
Duration:	April 2006 – April 2014
Status:	Continuation of project started in April 2006
Project leader:	Dr Sandra Lamprecht, ARC-Plant Protection Research Institute, Stellenbosch.

2. Long-term objective

To develop an integrated management strategy against Fusarium crown rot and take-all of wheat and barley in conservation tillage systems in the Western Cape province with special emphasis on crop rotation, tillage practices, nitrogen fertilization, placement of fertilizers and host resistance.

3. Objectives: April 2012 – March 2013

- Evaluate resistance/tolerance of wheat cultivars/selections against Fusarium crown rot under glasshouse and field conditions

4. Objectives: April 2011 – March 2012

- Evaluate resistance/tolerance of wheat cultivars/selections against Fusarium crown rot under glasshouse conditions

5. Progress on objectives: April 2011 – March 2012

A number of glasshouse trials have been conducted to evaluate the use of different hot water seed treatments to eliminate seedborne fungi from wheat seed to be used in resistance/tolerance tests against *F. pseudograminearum*.

Isolates (106) of *F. pseudograminearum* previously MAT-typed by Gert van Coller are also screened for virulence in order to select isolates to be used for glasshouse and field screening of cultivar tolerance/resistance.

The fungal infection rates and fungi associated with seed of eighteen wheat and barley cultivars to be used in glasshouse tests for crown rot tolerance/resistance were determined.

Glasshouse trials to test tolerance/resistance of wheat and barley cultivars against Fusarium crown rot will be conducted from September 2011 to February 2012.

A pilot field trial has been planted with the assistance of Sensako to evaluate the type of inoculum and inoculation technique and test the effect of fumigation or no fumigation on the reaction/tolerance/resistance of cultivars to Fusarium crown rot. The trial will be evaluated at the soft dough stage for incidence and severity of Fusarium crown rot and yields will be compared after harvest.

Data of these trials will be analysed for the 2012 progress report.

6. Progress on objectives: April 2010 – March 2011

- Determine the effect of tillage and crop rotation on the incidence and severity of Fusarium crown rot and take-all of wheat and barley (third year).

7. EXECUTIVE SUMMARY

The effect of different crop rotation treatments and within-treatment crop sequences and tillage practices on the incidences and severity of Fusarium crown rot and take-all were evaluated in four trials conducted by Johann Strauss/Mark Hardy and Johan Labuschagne (Department of Agriculture, Western Cape) at the Langgewens and Tygerhoek Experimental farms in 2010. Two of these trials, one at each of the two localities are long-term crop rotation trials, and the other two trials, also one at each location included both crop rotation and different tillage practices. The long-term crop rotation trial at Langgewens included the following crops: canola (C), lupin, (L), medic (M), medic-clover mixture (Mc) and wheat (W). Each rotation treatment was managed in a 4-year cycle. Rotation treatments (RT) and within-treatment crop sequences included in the present study were: RT A = W-W-W-W, RT B = C-W-W-W, W-C-W-W, W-W-C-W, RT C = C-W-L-W, L-W-C-W, RT D = W-L-C-W, L-C-W-W, RT E = M-W-M-W, RT G = M-C-M-W, RT H = Mc-W-Mc-W. The trial at the Tygerhoek Experimental farm included the following crops: canola (C), barley (B), lupin, (L), a medic/clover mixture (M), oats (O) and wheat (W). Rotation treatments are managed in 3-, 4- or 6-year cycles depending on the crop sequences involved. Rotation treatments (RT) and within-treatment crop sequences included in the present study were: (3-year cycle) RT 2a = W-M-M-W-M-M-W, RT 2b = O-M-M-O-M-M-O, RT 2c = B-M-M-B-M-M-B; (4-year cycle) RT 3a = W-M-W-M-W-M-W, RT 3b = W-M-O-M-W-M-O, O-M-W-M-O-M-W, RT 3c = W-M-B-M-W-M-B, B-M-W-M-B-M-W, RT 3d = C-M-W-M-C-M-W; (4-year cycle) RT 4a = M-M-W-W-M-M-W, M-W-W-M-M-W-W, RT 4b = M-O-W-M-M-O-W, M-M-O-W-M-M-O, RT 4c = M-W-B-M-M-W-B, M-M-W-B-M-M-W, RT 4d = M-C-W-M-M-C-W; (4-year cycle) RT 5a = W-L-W-C-W-L-W, W-C-W-L-W-C-W; (6-year cycle) RT 5b = B-L-W-B-C-W-B, W-B-C-W-B-L-W, W-B-L-W-B-C-W, B-C-W-B-L-W-B. In the crop rotation/tillage trials at Langgewens and Tygerhoek wheat was preceded by canola (C), lupin (L), medic (M) and wheat (W) in the following rotation treatments and within-treatment crop sequences (2007-2008-2009-2010): RT 1 = W-C-W-L, W-L-W-C, RT 2 = W-M-W-M and RT 3 = W-W-W-W. These trials also included four tillage practices viz. zero-till, no-till, minimum-till and conventional tillage referred to as tillage practice 1, 2, 3 and 4, respectively. Plants were collected at the soft dough stage. Parameters evaluated included the incidence and severity of Fusarium crown

rot and take-all, incidences of *Fusarium pseudograminearum* and *Gaeumannomyces graminis* var. *tritici* and the number of tillers/plant. The results contained in this report represent data for the third year of the second phase of the project. In the long-term crop rotation trial at Langgewens there were significant differences in crown rot severities and incidences between the different rotation treatments and within-treatment crop sequences, but not in the incidences of *F. pseudograminearum*. The highest crown rot severities were recorded for rotation treatments A (26.0) and B (33.9) and within-treatment crop sequences W-W-W-W (26.0), C-W-W-W (35.8), W-C-W-W (35.3) and W-W-C-W (30.7). The highest crown rot incidences were also recorded for these rotation treatments and within-treatment crop sequences. A significantly higher take-all severity (6.6) was recorded for monoculture wheat (system A) compared to the other systems. The highest mean number of tillers per plant was recorded for systems E, G and H and within-treatment crop sequences M-C-M-W (3.7), M-W-M-W (3.4) and Mc-W-Mc-W (3.3). Crown rot and take-all severity was significantly negatively correlated with grain yield. In the long-term rotation trial at Tygerhoek, crown rot severities and incidences, and the incidences of *F. pseudograminearum* differed significantly between the rotation treatments and within-treatment crop sequences. The highest crown rot severities and incidences were recorded for rotation treatments 3a, 3c, 4a, 4b, 5a and 5b. Crop sequences with the highest crown rot severities were M-M-W-W (77.0), M-W-M-W (58.5), M-M-O-W (58.5) B-L-W-B (52.7) and W-B-L-W (49.6). Crop sequences with longer breaks between wheat or barley had low crown rot severities and incidences, and incidences of *F. pseudograminearum*. Crown rot severity on oats was generally lower than on barley and wheat, but *F. pseudograminearum* was isolated from up to 46% of the oat plants in crop sequence M-W-M-O, but less from crop sequences with longer breaks with broadleaf crops such as O-M-M-O (16.0%) and W-M-M-O (28.0%). Crown rot seemed to be less severe on barley (34.8) planted after medic pasture (M-W-M-B) than on wheat (43.8) planted after medic pasture (M-B-M-W), but this difference was not significant. Crown rot severity did not differ significantly on barley (18.2) and wheat (29.9) planted after two years of medic/clover pastures (W-M-M-W and B-M-M-B). The highest take-all severity was recorded for rotation treatment 3a, 3b, 4a and 5b followed by 3b and 5b and the lowest for rotation treatments 2a, 2b, 3c, 3d, 4b, 4c, 4d and 5a. Significant differences were recorded for take-all incidences recorded for within-treatment crop sequences with highest incidences recorded for the M-M-W-W

and the lowest for the O-M-M-O crop sequences. The highest number of tillers for wheat was recorded for M-C-M-W, W-B-C-W and M-B-M-W. The number of tillers per plant was significantly positively correlated with yield. In the crop rotation/tillage trial at Langgewens, crown rot severity and incidences and incidences of *F. pseudograminearum* were significantly affected by rotation treatment and within-treatment crop sequence with higher severities and incidences on wheat planted after wheat and medic than after canola and lupin. Crown rot severity was significantly affected by tillage practice, with significantly higher severities of crown rot recorded for tillage practices 1, 2 and 3 compared to 4 (conservation tillage). The highest take-all severities were recorded for the monoculture wheat (rotation treatment 3) and the lowest for rotation treatment 1 (L-W-C-W, C-W-L-W crop sequences). Rotation treatment and within-treatment crop sequence did not significantly affect the number of tillers per plant, but tillage practice significantly affected the number of tillers with the highest and the lowest number recorded for tillage practice 4 and 1, respectively. In the crop rotation/tillage trial at Tygerhoek, crown rot was more severe and occurred more frequently in wheat following wheat in the rotation than in wheat following medic, canola or lupin. Zero-till and conventional tillage significantly reduced crown rot severity, crown rot incidences and the incidence of *F. pseudograminearum* on wheat. The highest take-all severities were recorded for the monoculture wheat (rotation treatment 3) and the lowest for rotation treatment 1 (L-W-C-W, C-W-L-W crop sequences). Tillage practice did not significantly affect take-all severity and incidence, but the incidences of *G. graminis* var. *tritici* were significantly less for plants from the zero-tillage treatment than those from the no-till and minimum-till treatments. Take-all severity was significantly negatively correlated with yield. Significantly lower numbers of tillers were recorded for monoculture wheat compared to rotation treatments 1 and 2. Tillage treatment also affected the number of tillers with the highest number recorded for tillage practices 1 and 4. In all the trials, Fusarium crown rot severity and incidences, and the incidences of *F. pseudograminearum* were significantly positively correlated and the same was reported for take-all severity and incidences, and the incidences of *G. graminis* var. *tritici*. The results obtained in this study showed that crop rotation and tillage significantly affect the severity and incidences of Fusarium crown rot and take-all, and that similar to the previous year, the effects are not always the same at the two production areas. The effect of crop rotation on these two diseases was clearly

demonstrated during the past three seasons. The effect of tillage practices is unfortunately not so clear at this stage, and it seems that no-till and minimum tillage can even increase the severity of these diseases. Since conservation tillage is promoted worldwide, it is important to establish the effect of this practice on diseases of cereals in order to develop sustainable disease management strategies for conservation agriculture. It may therefore be necessary to monitor the crop rotation/tillage trials again in future to obtain a better understanding of the effect of conservation tillage on crown rot and take-all of wheat in the wheat production areas of the southern and western cape.