WINTER CEREAL TRUST
PROGRESS REPORTS 2010-2011

BARLEY BREEDING PROGRAMME

GK 04/13: DETERMINATION OF ECONOMIC THRESHOLD VALUES FOR FUNGICIDE APPLICATION ON BARLEY
PROGRESS REPORT APRIL 2010 – MARCH 2011

Summary

Number: GK 04/13
Title: Determination of economic threshold values for fungicide application on barley
Duration: 1992 - 2012
Status : Continuation of the existing project
Project leader: Dr Ida Paul

Field experiments were planted at two localities in the Southern Cape during the 2010 season, Tygerhoek Experimental Farm and at Roodebloem near Caledon.

Disease pressure at both localities was extremely high with severe levels of net blotch and leaf blotch. Nemesia showed severe infections of both diseases (9) at both localities. SSG 564 was mainly infected with net blotch (8 to 9), while leaf blotch infections were limited to trace amounts at both localities, as can be expected from the resistance level of the cultivar.

At both localities the only main effect that showed significant differences in yield was the cultivars. Nemesia constantly had higher yields than SSG 564. At Tygerhoek none of the fungicide combinations applied had a significant effect on the yield if compared to the control treatment when SSG 564 (moderate reactions) was used. With the more susceptible cultivar, Nemesia, the only fungicide combination that had a significantly higher yield was Abacus at seven leaf stage and Duett at flag leaf stage. The yield results at Roodebloem showed that the fungicide combination, Abacus at seven leaf stage and Duett at flag leaf stage, as well as Abacus at seven leaf stage and Artea at flag leaf stage, showed significantly higher yields than the yield obtained with the control treatment when Nemesia was used. Only the combination Tebuconazol at seven leaf stage and Abacus at flag leaf stage showed a statistically higher yield than the control treatment when SSG 564 was used.

It is clear from the results that grain nitrogen percentage and kernel plumpness were not affected by any of the diseases. The significant differences found between cultivars at both localities, were purely the effect of the different yield levels that was obtained with the same nitrogen fertiliser management practices. At both localities none of the other main effects or interactions showed any differences as far as these two parameters are concerned.

GK 04/24: CULTIVAR RESISTANCE AS AN ALTERNATIVE IN COST-EFFECTIVE MANAGEMENT OF FUSARIUM HEAD BLIGHT IN SMALL GRAINS
PROGRESS REPORT APRIL 2010 – MARCH 2011

Summary

Number:	GK 04/24
Title:	Cultivar resistance as an alternative in cost-effective management of *Fusarium* Head Blight in small grains (Barley report).
Duration:	2003 - 2011
Status:	Final report
Project Leader:	Ms C I P de Villiers

During the year, 3 objectives were set and these objectives are summarised below. Trials were executed in Bethlehem and Douglas.

Bethlehem:

Laboratory trials:
Twenty-two single spore isolates need to be verified by PCR analysis, as well as twenty single spore isolates from Groblersdal and Koedoeskop*.* These single spore isolates from Groblersdal and Koedoeskop will be increased and be used in the inoculations during the 2011/2011 trials at Douglas and Bethlehem. Frankfort single spore isolates was used for inoculations.

Glasshouse trials:
Cultivars planted in the glasshouse included Puma, Cocktail and SSG585. These cultivars were planted to test for Type 2 resistance, but were not inoculated due to complications arising from severe mildew infestation.

Field trials:
Puma, Cocktail, SSG 585, Marthe and Christalia were included in this trial that was screened. The cultivars were planted in a randomised complete block design with four replications. Data collected showed that the infection percentage was low and varied from 0 - 15% between the cultivars. The data showed that the yield of the control plots and inoculated plots were not significantly different although there was a decrease in yield for the inoculated plots.

Douglas:

Field trial:
Barley nurseries consisting of 534 entries were planted at Douglas in 2 meter rows with 2 controls, namely SST 806 (susceptible) and Marico (moderate susceptible). A low natural infection percentage of fusarium was present and therefore entries were screened only for agronomic characteristics. The agronomy data of the different entries will be used for further selections.

Technology Transfer

One popular article was published in Wheat Focus Vol 28 (3) May/June 2010, pp 20-21. Title: "*Fusarium* aarskroei neem by besproeiing toe".

GK 07/10: DETERMINING GUIDELINES ON NITROGEN MANAGEMENT PRACTICES FOR THE IMPROVEMENT OF BARLEY GRAIN NITROGEN LEVEL UNDER IRRIGATION PROGRESS REPORT APRIL 2010– MARCH 2011

Summary

Number: GK 07/10
Title: Determining guidelines on nitrogen management practices for the improvement of barley grain nitrogen level under irrigation
Duration: 2007 – 2011
Status: Final report
Project Leader: W H Kilian

The research project on nitrogen management was conducted in two phases, in order to answer the questions producers had on the application of nitrogen to ensure maximum grain yield as well as an acceptable grain nitrogen percentage. Fertilisation guidelines for barley have not been researched well in South Africa and data is not available for barley under irrigation. A fertiliser program that aims at optimising grain yield, as well as quality, should be the objective for all barley producers. The source and amount of fertiliser applied is determined by the intended end use of barley. For malt purposes, the accepted N content of the barley grain must be between 1.7 and 1.9%.

The first phase was the testing of the effectivity of different nitrogen sources. Four nitrogen sources (Urea, Ammonium sulphate, Ammonium sulphate nitrate and Limestone Ammonium nitrate) were tested initially and it was shown in the report submitted during 2007 that these sources did not have a significant effect on either the grain yield or the grain nitrogen content of the barley crop.

In the second phase, the objective was to refine recommendations on nitrogen management in terms of the total amount of nitrogen and the growing stage(s) during which it should be applied.

This is the final report on the research findings of the second phase.

The grain yield of Cocktail increased significantly with the addition of nitrogen up to the maximum level of 200 kg/ha. Although higher yields were obtained with 200 kg N/ha, this increase did not differ statistically from the yield obtained with 150 kg N/ha. The yield measured with Puma showed increases with nitrogen amounts of up to 150 kg/ha and it decreased significantly at the 200 kg N/ha level.

The split application of nitrogen, where the majority of the total nitrogen was applied at the early stages (S1, S2 and S4) of planting and the tillering stage, produced the highest yield. The split application where nitrogen was applied later in the growing season at stem elongation or later (S3 and S5), significantly reduced grain yields.

Grain nitrogen percentage showed increases for both cultivars with every increment of nitrogen added, up to the 200 kg N/ha level. The values obtained with Cocktail were constantly higher than the values measured for Puma. The total amount of nitrogen needed for Cocktail to reach a grain N percentage of 1.7% was 200 kg N/ha. Because of the lower yields realised with Puma, the same value was reached at a nitrogen application of 150 kg N/ha.

Although yield levels varied between the cultivars, a similar reaction in terms of grain nitrogen content was measured. The application of nitrogen at the later growth stage of stem elongation (S3) showed significantly higher grain nitrogen percentages than the earlier application up to tillering stage or applications at heading later in season.

The average kernel plumpness value obtained in the combined analyses was 92.93%. The only main effect where a significant difference was measured was for cultivars, with average values of 94.53 and 91.33 for Puma and Cocktail respectively. These values are far above the minimum value of 80% required by the malting industry. No significant differences were found between any of the interaction treatments in the trial.

Recommendations on nitrogen management practices in terms of the total amount, as well as the timing of these applications, were developed from the research project.

GK 09/09 : BREEDING AND DEVELOPMENT OF TWO ROWED BREWING BARLEY PROGRESS REPORT: APRIL 2010 - MARCH 2011

Summary

Number: GK 09/09
Title: Breeding and development of two rowed brewing barley.
Duration: Ongoing
Status: Continuation of existing project
Project leader: Dr A F Malan

ARC-SGI mandated the barley breeding programme to develop well adapted malting and brewing barley cultivars for the cooler irrigation and Southern Cape dryland production areas of South Africa. To accomplish this goal, the breeding team needs to combine good agronomic characteristics (lodging resistance, high yield potential), disease resistance and good malting and brewing quality characteristics.

To lower production risks and costs for barley producers in the Southern Cape production area, the cultivars need resistance against diseases of which *Rhyncosporium*, *Pyrenophora* and leaf rust are the most common. To stay ahead of the continuous genetic change in the pathogens that overcome existing resistance, the combination of different resistance genes are very important.

In the cooler irrigation area, the disease resistance focus is on *Fusarium* head blight, a problematic disease in this production area. *Fusarium* has the ability to produce DON, which influence brewing quality.

This programme continuously incorporates new genetic variation into the program, to improve the above-mentioned traits. This was accomplished by annual screening of international barley nurseries received from CIMMYT for specific traits (*Fusarium* resistance, leaf rust and yield) under local cultivation conditions.

The programme delivered on all major objectives set for the programme. There is a continuous refining of the early generation screening methodology to enhance the breeding effort at a very early stage to be able to capture all the desired traits in a specific background.

From the micro malting results it is evident that the quality compares very well with the three local checks (Erica, Nemesia and SSG 564). In comparison with the high fermentable ideotype Harrington there is still much work to do. Unfortunately Harrington possesses genetics that negatively influenced kernel plumpness and probably with our early generation selection methodology we discriminate against the quality of Harington.

Line evaluation trials
One advanced ARC-SGI line (B06/05) is included in the 2011 Line Evaluation trial under irrigation, to be tested for agronomical performance against all candidate material for a possible release as a local malt barley cultivar.

Commercial production of barley
Currently Puma is a leading commercial barley cultivar for the irrigation area. Unfortunately SAB determine the annual production of the cultivar. Currently the production of Puma is capped at 30 000 tons per annum.

Disease resistance evaluation
During the 2010 season, international nurseries were evaluated at Douglas for SCAB resistance but, unfortunately the disease pressure was too low due to crop rotation change made by the co-worker.

Future of the Project (2011/2012)
- To exploit the high fermentable malt gene pool of Harrington to its full potential.
- To continue with the early generation screening methodology to increase the possibility of releasing an excellent malting cultivar for the irrigation production area.
- To release a well-adapted malt variety for the dryland and irrigation production areas.

- To develop disease resistant/tolerant barley varieties (*Pyrenophora*, *Rhyncosporium*, Rust resistance and *Fusarium* resistance).
- To utilise the HPLC to do more focused selections for malting and brewing quality characteristics in early generations of the breeding programme.