Wheat Calculator – a tool to optimise wheat production

**Key Points**
- The Sirius Wheat Calculator is a computer program that helps growers identify nitrogen (N) and irrigation (I) needs for wheat crops.
- It uses current and historical weather data to estimate yield, and has scenarios to look at the impact on yield of a dry or wet season.
- The program is interactive and allows growers to see the impacts of changing the amounts & timings of N & I.
- Graphs help the user see when N and water levels are low, the impact this has on the canopy and crop yield and whether their management is influencing leaching and residual N levels.
- Wheat growth stages and margins over N & I input costs are also presented.
- The program has been tested on farm for four seasons & has recently been made available to all wheat growers through a series of workshops.

**Introduction**

The Sirius Wheat Calculator (WC) is a Windows-based decision support system that assists growers to schedule irrigation (I) and nitrogen (N) fertiliser applications to maximise their profit and minimise adverse environmental effects.

The WC is based on the wheat simulation model Sirius which has been developed over many years with international collaboration by Crop & Food Research (C&FR). It simulates the growth of a wheat crop using daily sunshine, temperature and rainfall information. The simulations use current weather data from a nearby weather station where possible (until "today"), but look ahead to the end of the current season using scenarios of future weather obtained from historical weather data.

FAR has co-funded a project with MAF SFF and Ballance Agri-Nutrients which evaluated and improved on the WC using a group of growers who tested it with their crops and made suggestions for improving the WC’s presentation and performance. Research and development was carried out by C&FR. In conjunction with the software testing there were 5 field trials in each season to confirm the WC’s ability to predict grain yield and protein. Improvements were made to the WC each year with the new version then given to the project farmers to evaluate further.

**How does it work?**

The program is highly interactive and allows wheat growers to visualise the impact that altering application rates or dates has on gross margins and yield. It provides crop development information that is important for disease control and calculates N leaching.

The WC estimates yield based on management and environmental information that the user enters. The yield ‘potential’ is based on crops which have unlimited water and have no disease or nutrient deficiencies. The ‘schedule’ yield is the yield growers can expect to get if they follow the schedule operations; this also assumes no disease or limitations by nutrients other than nitrogen.

The WC estimates the future yield based on average weather scenarios and makes predictions about where the crop is at today based on actual weather data. These future scenarios assume regular rainfall events, eg. 20mm every 10 days for Lincoln; each site differs. As more actual weather data is saved, the yield prediction becomes more accurate.

Current weather data is sent out regularly by email from C&FR (CropCalcHelp@crop.cri.nz). Growers simply open the latest email and save the attached file containing the data into the appropriate file. Help files are incorporated into the WC if growers get stuck! There is also a helpline available (0800 400 464).
**Inputs**

Users choose a cultivar and a soil type from the list and select the sowing date. If your cultivar or soil type is not there, you can choose something similar. The most important factor when considering soil type is the depth to gravels and there are several generic types to choose from.

The WC estimates the N to be applied to grow a crop based on a current soil mineral nitrogen test (kg/ha). Growers should sample to 80cm if possible. It is recommended to split the soil sample into two depth increments if the sample is deeper than 30cm. This test determines the mineral N immediately available to the crop on the day of measurement. The WC calculates the amount of N mineralised each day.

The samples can be taken after planting, but leave enough time to get the results back before stem extension has started. This test gives a snapshot of soil N on that day, users enter the date the test was taken and the WC calculates the changes in N in the soil profile due to mineralization and leaching in response to rainfall and temperature.

Growers also need to enter information regarding irrigation and how frequently they apply N. It is also important to select the grain end use. This is because the WC optimises for yield, rather than protein. Selecting ‘milling’ will result in more N required to increase protein but yields may be over-estimated.

**Outputs**

The WC creates a schedule based on the inputs.

Whether their management is influencing leaching. Growers are encouraged to look at the graphs and alter dates and rates in the schedule to suit their requirements, tweaking management until the best yields and returns are achieved.

Growth stages, which are useful for timing management such as fungicide and N, are presented, as well as margins over N & I costs.

**Benefits**

Some of the benefits the growers found while evaluating the software are:

- Useful for predicting growth stages in advance e.g. GS 31, 32, 39 and harvest. Fungicides and PGR’s can be targeted at the right time and contractors can be arranged in advance.
- Provides a window in which to apply N, which means you can wait for the right weather conditions without compromising yield.
- Irrigation timing and rates can be optimised to suit crop requirements.
- Economic benefits because of increased yield from better timing, or targeting of increased N inputs, or by achieving maximum yields with less N.
- Better understanding of how the wheat crop grows, the factors which influence canopy development and why the size of the canopy is so important.

**How do I get a copy?**

In July 2005, a series of workshops was held around NZ on “Optimising profit from wheat production”. These workshops gave wheat growers a valuable background to wheat growth and development and provided important knowledge to help users understand the WC. The WC was made available to those growers who attended the workshops. This version expires in April 2006.

The WC is only intended as a guide to wheat management, and growers need to have a good knowledge of wheat growth and development to be able to get the most out of it. Ideally, any future releases will also be held in conjunction with workshops.

Currently, the program has been made available free of charge as part of the project. But there is likely to be a cost associated in the future to cover the costs of providing weather data, updates and support.

If you are interested in obtaining a copy of the WC, please contact FAR. Further workshops are planned for September to introduce growers to the principles behind the WC and how to maximise its benefits.