NIAB TAG Focus

Staying in touch with the work of NIAB TAG

Pre-Breeding: The Smart Carbohydrate Centre

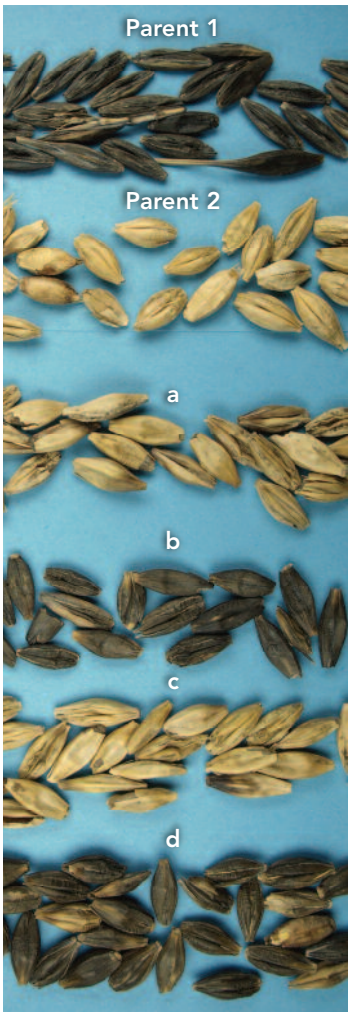
The Smart Carbohydrate Centre is a collaboration between NIAB and JIC that is making the discoveries of world-leading starch scientists accessible to industries that need to explore the value of novel starches. At NIAB, state of the art breeding techniques are used to develop a suite of near-isogenic lines of an elite barley variety, into which variants of four starch genes with clear commercial interest were introgressed.

Using marker-assisted selection the resulting lines are available in quantities that allow meaningful analysis of the starch characters to be performed. With JIC and the consortium of interested parties (including brewers, maltsters and bakers who were involved in guiding the project from its inception) we will soon understand the effects of changes in starch genes on the processing qualities of barley.

The Smart Carbohydrate Centre has benefited from BBSRC CSI funding in its initial stages. We are seeking further funding to expand the range of characters and genotypes in the Centre, and to include wheat starch.

Smart Carbohydrate Centre making normal seeds containing novel starch. The seeds on the left are a novel starch parent with typically shrunken grains whilst the seeds to the right are an improved line that contains the mutant starch allele but are more acceptable to processors.

Barley lines produced by the Smart Carbohydrate Centre



Parent 1: Novel Starch Mutant the grain is shunken, low yielding.

Parent 2: Elite UK barley.

a,b,c and d are breeding lines a b and c carry the novel starch allele; the grains are 'dented' but the grain is much less shrivelled than parent 1.

d has the wild type allele from the elite; the grain is much plumper than a,b or c.

The grain colour alleles are segregating independently from the star alleles.

Members' Research Programme

NIAB TAG conducts an extensive annual field trials programme that is exclusive to, and funded by, its members. The aims of this research are to:

1. Generate robust, independent data to underpin the crop management advice provided to members;

2. Address, in a practical context, fundamental agronomic issues that threaten the longer term profitability or sustainability of current production methods.

Technical Committees representing each of the trials centres play a key part in determining priorities at a local level and guiding the national research strategy.

New initiatives include the establishment of a 'Black-grass Centre'. Research will evaluate the potential contribution of cultural control methods such as cultivation depth and timing, cropping breaks and crop competition on management of this (and other) grass weeds. Further work is examining the impact of nozzle type and other application parameters on grass weed herbicide efficacy. A related study will assess ways of preventing sterile brome ingress from field headlands.

Other new projects include the effects of sowing date and row spacing on the performance of winter oilseed rape varieties, and the impact of winter wheat variety characteristics on their suitability to wider row spacings and their relative nitrogen use efficiencies.

Wide rows in winter wheat. New research is examining the effect of row width on the canopy structure of winter wheat varieties with high and low tillering propensity.

Silsoe Spray Applications Unit

The NIAB TAG Spray Application Unit at Silsoe is an internationally important facility for the development and measurement of spray application systems, with particular expertise concerning agricultural pesticides.

The unit has a team of specialists with established research experience in spray generation, transport and deposition. This expertise relates to the conducting of field experiments and laboratory work. The laboratory work includes the use of a specialised wind tunnel at the Unit; this provides an environment where application systems can be examined under controlled scenarios for wind speed, humidity and crop/surface conditions.

Among other things, specific research at the Unit has examined:

- **Nozzle Performance**; including measurement of velocity distributions, droplet size and volume distribution patterns;
- **Spray Deposits**; through visualisation and on-surface measurement this can be used to determine coverage and quantity of spray applications;
- **Spray Drift**; laboratory and field measurement of parameters including airborne droplet profiles, ground deposits and vapour concentration.

Mathematical modelling is also an important aspect of the research at the Unit. Obtaining experimental data, particularly in the field, can be time-consuming and costly. Mathematical models can be valuable in mapping from laboratory to the field and in extrapolating field data.

Crop Genetic Transformation

A genetically modified organism has had a new gene or set of genes added to its genetic material. In the case of plants, these can be introduced by a naturally occurring soil bacterium, *Agrobacterium tumefaciens*. The bacterium inserts a small piece of DNA containing the new gene into the plant cell, and from the single transformed cell, a normal fertile plant can be regenerated. This process occurs in the natural environment, with specific bacterial genes being inserted into the plant cell, but in a limited range of species. Over the last 30 years, significant advancements have been made to this technology, extending the range of crop species which can be transformed.

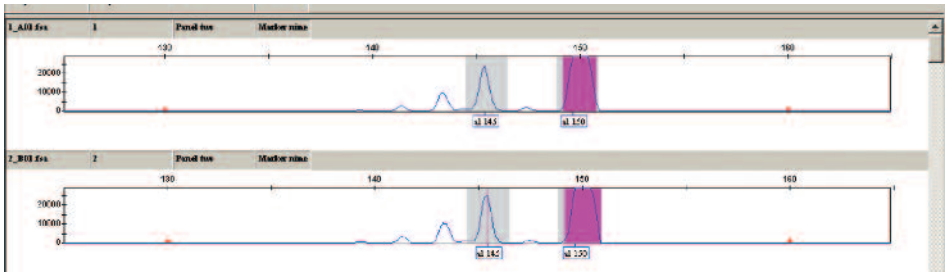
GM crops have to date largely been confined to traits giving resistance to herbicides or insects, but a new generation of traits which confer drought tolerance, disease resistance, yield improvements or health benefits are now being examined. This technology is an important tool in the drive to increase food production in a world with an expanding population and a changing climate.

NIAB houses a Crop Transformation Team which mainly focuses on wheat. Using this technology we can add one (or a few) new genes into a wheat cell, which already contains an estimated 150,000 genes, and regenerate a new "fine-tuned" wheat plant. NIAB offers an independent and efficient wheat transformation service to academic and commercial partners. It allows both functional analysis of genes for research, and importantly a viable route to breeding new traits for commercial exploitation.

Molecular marker test could help with variety ID issues

The development of a new test at NIAB TAG could help growers get to the bottom of field contamination problems in oilseed rape crops. The Agricultural Crops Characterisation team has been working alongside the Analytical Services team on the development of a molecular marker test to check whether new seed stocks of a variety match the original seed submitted for National List testing. In the second year of testing the seed submitted for Value, Cultivation and Use (VCU) comes from a different source and therefore has to be grown alongside the original Distinctness, Uniformity and Stability (DUS) seed to ensure that the same variety has been submitted for VCU trials. This currently means growing over 100 extra plots each year which are visually assessed within the DUS trial.

The new test uses Simple Sequence Repeat (SSR) markers to test the seed stocks within a laboratory and means that the results can be obtained much quicker, avoiding the necessity of growing extra plots. So far about 35 varieties of winter rape have been tested with promising results and the new test for DUS/VCU authentication will be implemented in the 2011/12 growing season. It is hoped that a database of winter rape varieties can be established so that the test can be offered to growers as a means of variety identification for seed or volunteer contamination issues in the field. A similar test is already being offered by NIAB TAG for variety identification in potatoes and tomatoes and has proved to be very successful.



DUS and VCU seed sample profiles showing matching peaks for the same variety

Side by side plots of winter rape for visual comparison

Farming Systems Research

The average farm rotation uses a range of crops and cultivation approaches. It is therefore important that research considers the rotation as a whole and the interaction of the individual elements (as well as looking at these aspects in isolation); however, long term rotational system studies are becoming increasingly rare. Recognising both the practical and strategic importance of these areas, dedicated farming systems research is being actively pursued within NIAB TAG, and our unique expertise continues to push the boundaries in this type of research. Two of the main research projects are:

- New Farming Systems (NFS): this study is a charitably funded initiative, delivered through NIAB TAG at Morley (Norfolk), supported by The Morley Agricultural Foundation and The JC Mann Trust. The NFS project is seeking routes to address energy usage and pollution risks in conventional rotation systems and to develop this research to find ways to maintain or increase financial margins whilst reducing the footprint of conventional farming. This long term rotational research is looking specifically at aspects of cultivation, fertility building and soil amendments;

- The STAR project (Sustainability Trial in Arable Rotations) was initiated in autumn 2005 at Stanaway Farm (Suffolk) and is funded though the Felix Thornley Cobbold Trust. The objective of the experiment is to study the sustainability of different establishment techniques within different arable production rotations on a heavy soil type. The trial is fully replicated and makes use of farm scale equipment and techniques.

NIAB TAG

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Be the best in your field

What is ASSET?

The Agricultural Science Student Education Training (ASSET) programme is run by NIAB TAG and provides a valuable point of exchange with undergraduate students studying agronomy modules and their tutors at four leading crop science universities: Reading, Harper Adams, Newcastle and Nottingham.

The scheme is a mechanism through which NIAB TAG is able to:

- Commit final year financial support to an outstanding student at each partner university.
- Promote career opportunities in the arable sector, crop sciences arena and at NIAB TAG.
- Present the work carried out by NIAB TAG.
- Maintain communications with key individuals teaching agronomic science in the UK.

Who can apply to the scheme and how does it work?

In order to be considered for the ASSET Award students must be registered to complete a specific crop based module in their second year as defined by each partner university.

What are the benefits of participating in the programme?

Participation in the programme serves to encourage students in their studies. We hope it also helps to inspire individuals to understand better how they might aim to make a difference to the UK agricultural industry in their future careers.

In addition, winners receive a £3,000 bursary which is presented at a ceremony associated with a key technical event. All expenses are covered and the event is selected to be informative and relevant to the students' final year studies.

Support

The ASSET Programme is funded by NIAB TAG in partnership with generous support from The NIAB Trust and The Morley Agricultural Foundation.

NIAB
National Institute of Agricultural Botany Trust

THE MORLEY AGRICULTURAL FOUNDATION

To find out more about the ASSET Programme please contact us.

NIAB TAG

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