

NIAB'S INNOVATION FARM DEMONSTRATES POWER OF GENETICS

by Richard Crowhurst

After two years of informal assessment, this year has seen more publicity and more events surrounding NIAB's Innovation Farm concept than ever before. In early September horticultural crops become the focus at for a workshop at what NIAB calls a 'demonstration and networking facility for businesses, innovators and stakeholders in the agricultural and horticultural sectors.'

All the crops highlighted at the Innovation Farm have been researched in the UK or Europe and the focus is on demonstrating how the genetic resources of plants can be used to overcome the challenges associated with issues such as climate change, food security, health and sustainability.

Dr Lydia Smith, Programme Leader at NIAB, explained that the Innovation Farm was a new facility which had been piloted before a couple of years before its public launch. "It's about

new visitor centre will soon be build on the site, while there are also plans to move the Innovation Farm demonstration field to the same location.

The workshop itself touched on a host of genetic related subjects, from cutting edge research to how new varieties have provided new opportunities for growers.

Ethylene as a sprout suppressant

Over the last 8 years or so, ethylene has been adopted by the potato and onion industry as a sprout suppressant, and while it is working for growers, the science of why it works is still not fully understood. "The science is trying to catch up with the industry," explained Dr Leon Terry, Head of Plant Science at Cranfield University. "We don't really understand how ethylene is extending the storage life of onions and potatoes."

One of the factors about ethanol use which puzzled Dr Terry was the fact that growers are required to apply ethylene throughout the storage season,



Visitors look at NIAB's new state of the art greenhouse complex.

rather than at a particular time. "It seemed strange to treat throughout the season and we wanted to see if there were more optimum times of use from a biological perspective."

The work has shown that, for some potato cultivars, storing in air and applying ethylene at dormancy break can be effective as controlling sprouting as the use of continuous ethylene at 10ppm. However, this is not the case for all varieties. Not only does this make agronomic recommendations almost impossible, but indicates a complex genetic explanation for the way in which ethanol affects potatoes in store.

The situation with onions is even more complex as 1-MCP appears to have the same sprout inhibiting effect on the crop as ethylene, but is known to work in a different way. A series of experiments has shown that there are also varietal differences in the response to both ethylene and 1-MCP, suggesting that there is likely to be more than one ethylene binding site in onions with 1-MCP only affecting some of them.

Salad discolouration

David Pink, now Professor of crop improvement at Harper Adams after a long career at

Warwick, discussed how identifying genetic markers for particular quality traits can aid breeders, particularly in the case of post harvest factors, such as the discolouration of cut surfaces on lettuces.

Work by David and breeder Rijk Zwaan had shown that there were both environmental and varietal effects, leading him to look for genetic markers for the trait. With the issue of discolouration becoming increasingly important with the growth of the bagged salad market, the research could provide an effect screening tool for breeders.

"We used a technique developed for a separate HORTlink project to score post harvest discolouration in these lettuce lines," explained David. "This was then converted into a statistical figure." Backcrossing provided stable lines which were then planted in trials at Wellesbourne and at Rijk Zwaan's trial site in The Netherlands. "Within the population there was a variation between browning and pinking. We did find effects from the site, which is what we'd expected, but we were also getting significant differences due to the genotype."

By overlaying the observed differences in phenotype with an existing genetic linkage map for the nine chromosomes present in lettuce, it is possible to identify 'Quantitative Trait Loci,' which are areas of the



Dr Lydia Smith, Programme Director at NIAB.

raising the profile of research and what's going on," she explained. "A lot of the research we are showcasing is not NIAB TAG work, but comes from partners across the country."

There was also the chance for visitors to view demonstration plots in the field and NIAB's new state of the art greenhouse complex. As well as featuring state-of-the-art climate control and biomass heating systems, there is plenty of room for expansion and it is hoped that a



Dr Leon Terry, Head of Plant Science at Cranfield University.



David Pink, Professor of Crop Improvement at Harper Adams.

lettuce chromosome associated with a particular trait.

Further trials with **Nunhems Seeds** then compared traditional breeding selection methods in the field with market assisted selection, or picking trial varieties based on their genetic map. "In this case we tested whether you can use these markers as indicators for breeding for resistance," explains David. Statistically, in terms of discolouration, the breeder's eye was no better than a random selection while the genetic assessment proved good at recognising susceptible varieties, but not for judging resistance

The genetic assessment also failed to take into account other factors which would make a variety commercially viable. "This is still a relatively expensive technology and you

can't breed for every trait using markers," concludes David. However, new developments and significant investment by seed companies are changing the landscape. "The limiting factor is down to how many traits the breeder can look at."

The future for onion production

Breeders are running a constant race against time to improve the varieties on offer to growers says **Nigel Kingston** of **Syngenta**. By comparing onion production twenty years ago with today, he tried to predict the key factors facing growers for the coming decade. Air drills would remain the main method of planting, while the use of coated natural seed is likely to increase, although there will remain a role for pelleted seed in traditional markets. "In terms of varieties, I think we will see a range similar to today, with new resistance coming in, along with coloured and sweet varieties, etc.," predicted Nigel.

He also stressed that whatever new innovations the future may bring, growers cannot forget the basics, starting with the importance of soil and agronomy. "Plant vigour is vital and the root system needs to be strong," he said. "We like to have early maturing varieties; the more we can harvest in August the better." The current crop of good storing onions from Syngenta began in 2000 with varieties like Wellington and Sunshine, while Vision won the NIAB cup in 2009 and the most recent introductions have included Attraction (SG 8295), Motion (SG 8301) and Medallion (SG 8353). If all goes according to plan, the next raft of commercial introductions could be available in 2012.

Nigel also pointed out that one key challenge for vegetable breeders is to increase yields, which have not kept up with the strides seen in cereal crops. For example, the average UK onion yield in 1993 was 16.9 t per acre, while by 2010 it had risen to just 17.6 t per acre, an increase of just 3.8%. Not only is increasing yield vital to feed an increasing population, but also to keep production economically viable in an era of increasing energy costs. "I believe the onion area will



NIAB's Bruce Napier discusses breeding in the demonstration field.

increase in line with productivity," explained Nigel.

Low carbon carrot

In carrots, the introduction of Eskimo from **Nickerson Zwaan** shows the benefits of breeding for the market according to the company's **John de Soyza**. The result is what could be the world's first low carbon carrot.

Bred by Vilmorin as a variety to withstand cold, the variety "combines freezing resistance with other favourable traits such as anti-breaking and quality," says John. Initial industry scepticism has been overcome as growers have seen how the variety can fit into late season programmes.

"Sometimes something comes along that growers didn't realise they wanted," he adds.

"We continued to develop our understanding and to work

with growers," he explains, adding that high straw prices and the loss of a premium on late season strawed crops have also combined to increase grower interest in the variety.

Although the harsh winter conditions of 2010 underlined that Eskimo is tolerant, not immune, to frost, the majority of growers have increased the proportion of Eskimo in the programmes this year. In fact, John believes that there is the potential for Eskimo to replace as much as 25-30 per cent of the traditional strawed area in the UK for production up to late January or early February in some years.

In 2008 Nickerson approached **Dr Peter Wright** to assess the oil-based carbon inputs associated with the production of carrots from straw and polythene covered crops. Using information supplied by a group of surveyed growers, he calculated that standard strawed production has a carbon footprint of 110 kg of CO2 equivalent per packed tonne compared to just 36kg for Eskimo.

While accepting that Eskimo is not the sole solution to late season carrot production, and that other methods including strawed production, cold storage and imports are needed to provide a 12 month supply of carrots, John points out that, "Eskimo gives growers the opportunity to do something different to protect against frost. We feel Eskimo could make a very significant contribution to reducing the carbon footprint of late season carrot production in the UK."



Nigel Kingston of Syngenta looked at the future for onion production.



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