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NATIONAL TILLAGE CONFERENCE 2017

Crops
Environment
& Land Use
Programme

National Tillage Conference 2017

Teagasc
Agriculture and Food Development Authority

NATIONAL TILLAGE CONFERENCE 2017

Coping with, and managing risk on tillage farms

Published by

Teagasc

Crops Environment and Land Use Programme

Oak Park Crops Research

Carlow

Thursday, 26th January 2017

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Programme

09.30	Registration /Tea/Coffee
10.30	Conference Opening ***Frank O'Mara, Director of Research, Teagasc***
Session 1:	***Chaired by John Spink, Head of Crop Science Department***
10.45	Prospects for grain prices and managing volatility ***Andy Doyle, Irish Farmers Journal***
11.05	Grain use for alcohol production in the UK ***Sarah Clarke, ADAS***
11.50	Oilseed rape and beans: Growing the markets ***Dermot Forristal, Teagasc***
12.10	Ballykilcavan Farm*:* Diversification and risk management ***David Walsh-Kemmis, Farmer, Laois***
12.30	The maize guide and inter-farm trading ***Kevin Cunningham, Chairman of Maize Industry Group & DLF Business Manager***
12.45	Panel Discussion
13.00	Lunch
Session 2:	***Chaired by Paddy Browne, Head of Programme CELUP***
14.30	Fungicide resistance update: wheat and barley ***Steven Kildea, Teagasc***
14.50	Barley disease management: Optimising fungicide timings and rates ***Liz Glynn, Teagasc***
15.10	The value of variety choice in cereals ***Joseph Lynch, Teagasc***
15.30	***Research Update, 5 minute presentations***
	Grass weed herbicide resistance ***Rónan Byrne, Teagasc***
	Aphid monitoring and resistance ***Louise McNamara, Teagasc***
	Oilseed rape row spacing and seed rate ***Roisin Byrne, Teagasc***
	Understanding genetic resistance to Septoria ***Ger Hehir, Teagasc***
	Genome editing – what is it? ***Ewen Mullins, Teagasc***
	Factors affecting eyespot in winter wheat ***Henry Creissen, Teagasc***
16.00	Close of Conference Professor Gerry Boyle, Teagasc Director
16.15	Tea/Coffee

Contents

Prospects for grain prices and managing volatility

Andy Doyle
Tillage Editor, Irish Farmers Journal

SUMMARY

Grain prices are important to the delivery of profit on tillage farms and this is especially the situation in high cost sytems. Prices are heavily impacted by market sentiment but ultimately supply and demand dictate. However, sentiment trades on information and opinion and these have the potential to provide volatility in the market. Sometimes volatility will pull prices down while other times it can pull prices up. Volatility is an integral part of a market where weather has such a big impact on the potential for output in so many different parts of the world. Volatility should not be seen as being all bad as it can often provide price spikes and selling opportunities at above market values.

Grain prices have been strongly influenced by the last four large global harvests which have resulted in oversupply and increased global stocks. The presence of over 500 million tonnes of grain stocks provides a buffer to supply and is likely to dampen upward price movement in the event of reduced production in the short term. It is important for growers to remain conscious of this element of supply as it is likly to help keep a rein on prices should there be production issues in the year(s) ahead, that is until stock levels decrease.

Over the past two decades global production has increased by 575 million tonnes with consumption broadly similar. Global production levels have been helped by high yields but also an additional 180 million acres coming into production in the past decade. It is only in the past four years that consumption has not been able to keep pace with production as a result of the four consecutive big harvests. These record big harvests have resulted in generally lower price levels with very few price spikes to provide selling opportunities.

However, there have been forward prices in the market that would have added considerably to farm incomes if they were partially or fully availed of. But care is still needed with forward selling in terms producing the quantity sold and meeting the quality specifications, especially with dry grain. That said, growers must look seriously again at the option to forward sell and learn to judge price against market sentinent rather than just its absolute value.

Profitability is not just a matter of price however and all items of expenditure must also be continuously examined in terms of their cost benefit. When prices are low the economic benefit of many inputs generally relflects lower usage. A tighter rein is needed on longer term machinery investment. Scale, especially through conacre access, must be questioned as repositioning costs does not make them go away, it just means that other acres pay their bills.

Prospects for grain prices and managing volatility

Andy Doyle

Irish Farmers Journal

Many challenges to profitability

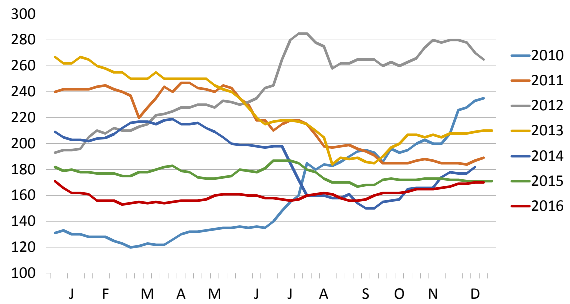
- Product prices
- Costs: chemicals, fertiliser, machinery, land
- Large global grain stocks
- Condition of soil
- Lack of crop options
- Lack of good rotation
- Lack of analysis at farm level

Product prices

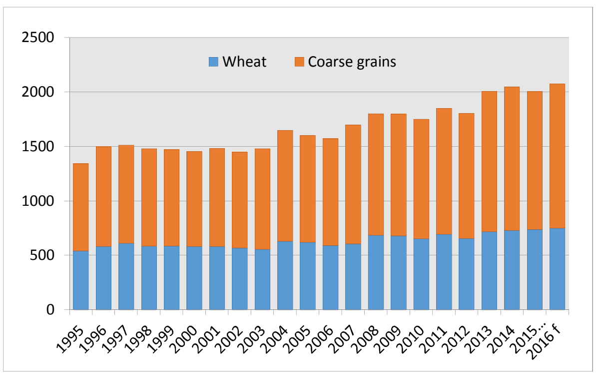
- Is price too low or cost too high, or both?
- Recent price swings have been predictable based on higher production and lack of a new demand driver
- 2004 – 2016 ⇨ Production up by 35Mt per annum
- Markets remain volatile as funds await opportunities

Spot wheat prices in Ireland 2010-2016

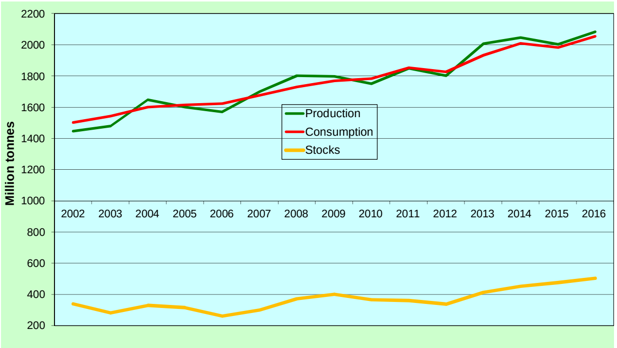
Spot wheat prices in Ireland



World wheat and coarse grain production (Mt)



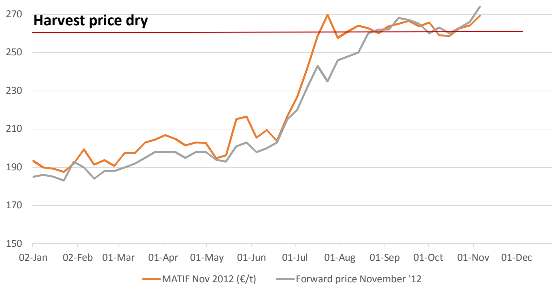
World grain supply/demand/ Stocks



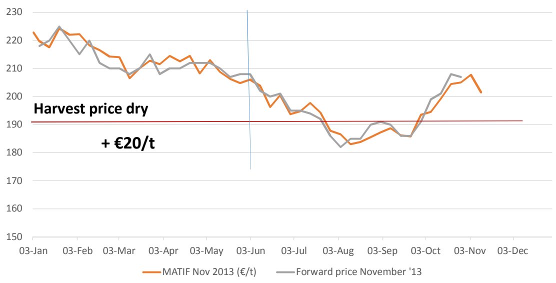
Supply / Demand / Price

- Total supply impacts on price but sentiment is more volatile
  - Planting intentions
  - Conditions at emergence
  - Diseases
  - Drought
  - Pests
  - Wet
  - Extreme weather events
  - Politics
- All impact on sentiment and price

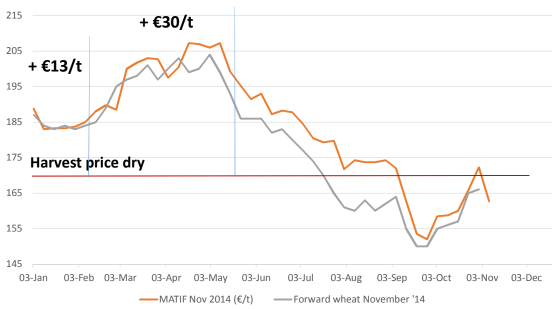
Futures and forward wheat price movement 2012



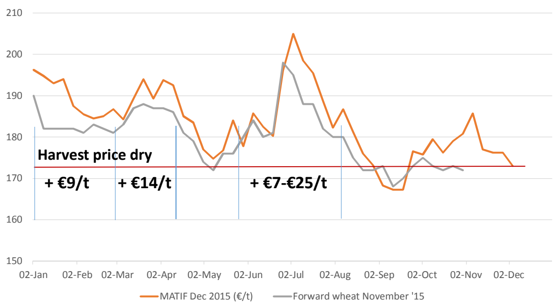
Futures and forward wheat price November 2013



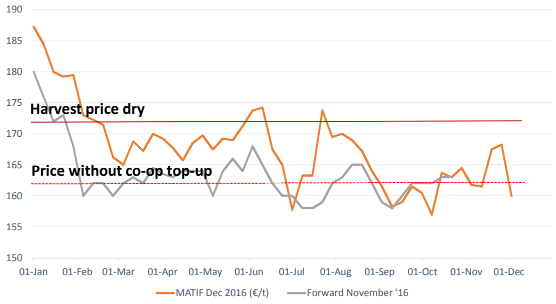
Futures and Forward wheat price November 2014



Futures and Forward wheat price November 2015



Futures and Forward wheat price November 2016



Outlook for 2017

- Stocks provide big supply buffer
  - Supply pressure will take some time to unwind
- Winter plantings are generally up
- Markets trade daily sentiment and may give selling opportunities
- Higher output expected in South America
- Are continental regions due a poor year - drought?
- Grain prices likely to remain weak
- Drought, damage, floods could all happen again

Grain use for alcohol production in the UK

Sarah Clarke
ADAS Gleadthorpe, Meden Vale, Mansfield, Nottinghamshire, UK

SUMMARY

The long-established markets for brewing and distilling in the UK demand around 1.9 M t of UK-grown barley each year, as well as ~700,00 t wheat for distilling. In recent years, a market has developed for wheat for biorefining, with the resulting alcohol being used for inclusion in petrol as part of the Renewable Fuel Transport Obligation (RTFO), which requires that fuel suppliers include a specified percentage of renewable fuels in their products (currently ~4%). Two plants in the North East of England currently produce bioethanol from wheat (Ensus and Vivergo) and at full production capacity demand ~2 M t of feed wheat.

The process for producing bioethanol is broadly similar to that for potable alcohol. The grain is milled and enzymes added to break-down the starch to glucose. The resulting mash is fermented and then distilled to concentrate the alcohol. As well as ethanol, a useful animal feed, DDGS (Dried Distillers Grains and Solubles) is also produced. From every tonne of wheat processed, approximately 435 litres of alcohol (~20 l/t less than maize) and 305 kg DDGS are produced. However, production will vary with the crop. Since the amount of alcohol produced depends directly on starch content, there is an inverse relationship between alcohol production and protein contentration; alcohol production is reduced by 7 litres per dry tonne for every 1% increase in protein concentration. Processing efficiency can also be affected by the Non-Starch Polysaccharide (NSP) content of the grain. They have a high water binding capacity and significantly increase the viscosity of the mash, leading to problems in processing and reduced throughput.

A recent project examined the potential for triticale in the bioethanol market. In direct experimental comparisons, triticale produced greater yields and lower protein concentrations than wheat, indicating a greater alcohol production potential. However, when bioethanol yields were determined in the lab, results indicated that tritiale gave lower alcohol yields than wheat, possibly due to higher levels of NSPs than wheat.

For growers thinking to grow for this market, soft-milling, high-yielding varieties are recommended. To maximise starch production, crops need to be managed for high yields, but low grain proteins by avoiding over-application and late-application of Nitrogen.

Grain Use for Alcohol Production in the UK

Sarah Clarke

www.adas.uk

Overview

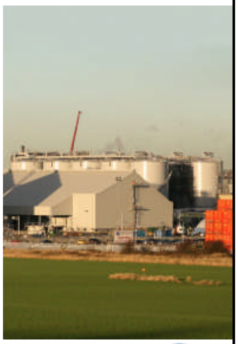
- Current UK demand for grain for alcohol production
- Bioethanol production
- Alternative cereals for alcohol production
- Growing for alcohol production

Current UK demand

- Brewers, Maltsters, distillers:
  - ~1.9 M t barley
  - ~700,000 t wheat
- Bioethanol production in North East England since 2012
  - Up to ~2 M t wheat

Bioethanol market

- Vivergo in South Yorkshire
  - Uses up to 1.1 M t wheat per year
- Ensus in Teeside
  - Uses wheat + maize
- Producing:
  - Bioethanol to satisfy RTFO
  - DDGS for animal feed



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RTFO

- Renewable Transport Fuels Obligation obliges all fuel suppliers to include a % of renewable fuels (currently ~4%)
- Renewable fuels have to demonstrate a Greenhouse Gas Saving of 50% compared to fossil fuels

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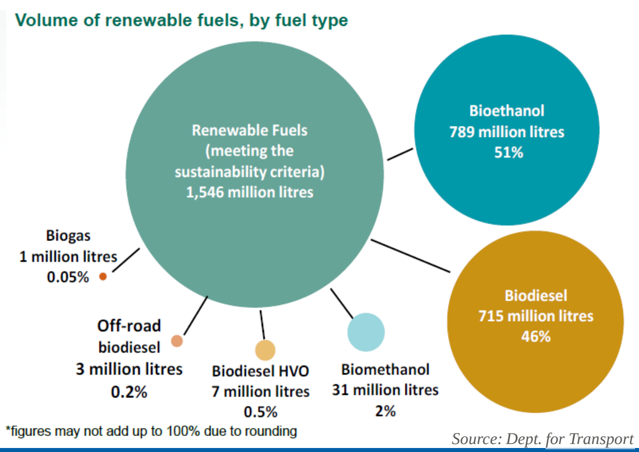
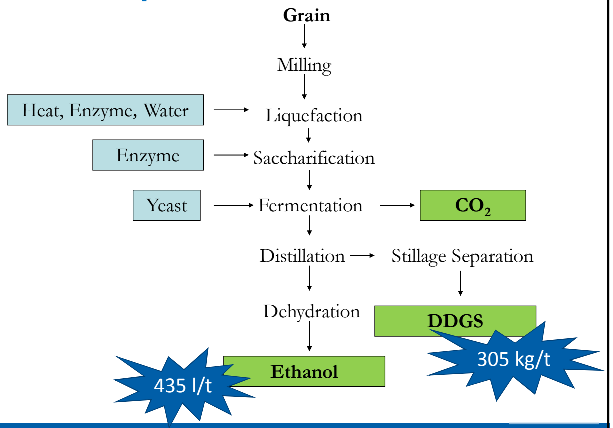


Bioethanol production



Factors affecting production

- Crop
  - Maize produces ~20 l/t more ethanol than wheat
- Starch
- Milling
- Non-starch polysaccharides
  - Increases viscosity
  - Depends on variety and species – less viscosity in maize than wheat
- Grain protein concentration

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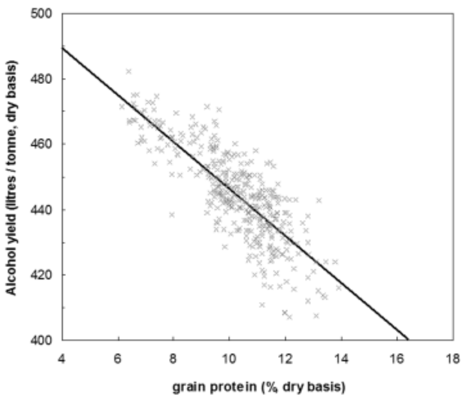
Alcohol production and grain protein



Alcohol production decreases by 7 l/t per 1% increase in protein

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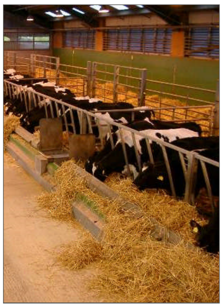
DDGS quality

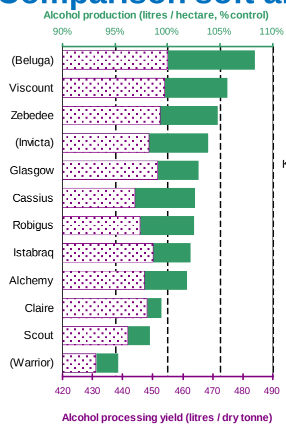
- DDGS used for animal feed – particularly ruminants
- Protein and fibre contents are ~3 times higher than grain
- Utilisable energy for non-ruminants is lower

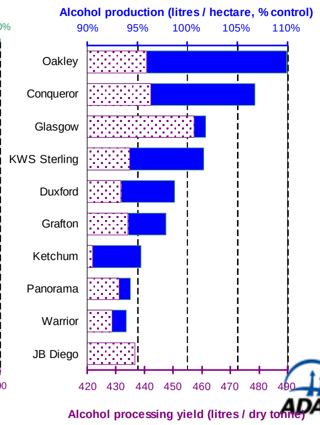


Crop management

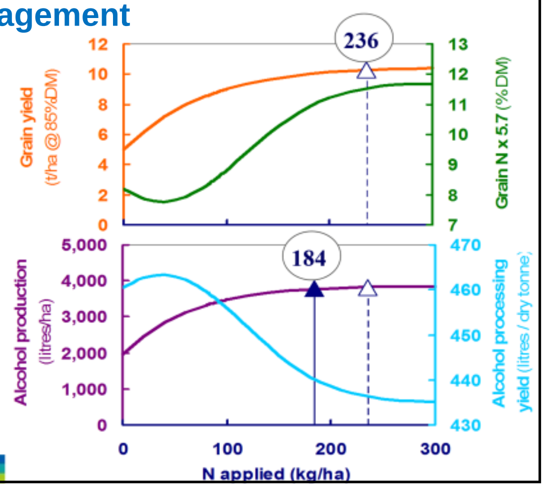
- **Which variety ?**
- **How much N ?**
- **Alternative species e.g. triticale?**

Comparison soft and hard wheats





N management



Developing triticale into a high yielding and profitable crop for feed and biofuel

Aim
- Develop triticale into a profitable crop

Methodology
- Compare triticale with wheat across environments
- Evaluate grain, alcohol & feed quality in the lab
- Test triticale against wheat in on-farm trials

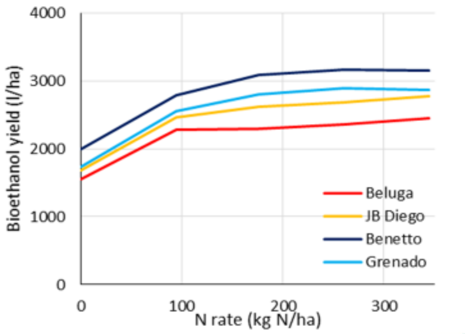
Innovate UK agrovista SÜDZUCKER CF RAGT senova SAATEN UNION ADAS

Developing triticale into a high yielding and profitable crop for feed and biofuel

Outcomes:
- Triticale out-yielded wheat in 15 out of 20 sites; yield advantage was 8% as a 2nd cereal and 3% as a 1st cereal…
- … but there was no difference in optimum N rate
- Pig DE and NE were very similar for the two species
- Triticale gave lower alcohol yields per t, but higher per ha

Innovate UK agrovista SÜDZUCKER CF RAGT senova SAATEN UNION ADAS

Developing triticale into a high yielding and profitable crop for feed and biofuel



Innovate UK agrovista SÜDZUCKER CF RAGT senova SAATEN UNION ADAS

Irish wheat for bioethanol?

- High Yields? ✔
- Low protein? ✔
- Soft endosperm? ✖

ADAS

Summary

- Demand for wheat for potable alcohol and bioethanol in the UK
- Bioethanol production produces alcohol for inclusion in fuels plus DDGS, a useful animal feed
- Crops for bioethanol managed for high yield and low protein
- Irish wheat has good potential for alcohol market

ADAS

Thank you

www.adas.uk

Oilseed rape and beans: Growing the markets

Dermot Forristal and John Spink
Teagasc, CELUP, Oak Park

SUMMARY

Irish crops are produced with limited rotation practice. Consequently the reduced proportion of 'first' cereals results in greater disease, weed and pest challenges; poorer yields and weak economic margins. The absence of a good break-crop market impedes the adoption of rotations. Development of improved markets for break crops requires a sustained input from all stakeholders: policy makers, industry, research/development organisations and growers.

Previous studies have confirmed that beans and oilseed rape (OSR) are the two non-forage break crops with most potential in Ireland. Both crops are grown in Ireland but account for just 6 - 8% of the cropped area. The frequently held perception that break crops are unprofitable, difficult to manage, and risky, is impacting on adoption and may not be accurate. While current bean production margins are heavily dependent on support and OSR returns similar margins to cereals, when the rotational benefits of these crops are considered, they can bring €151 to €176 / ha extra annual profit to a rotation. The area of beans produced has increased rapidly in the last two years with the protein support scheme, but demand from their main market, the livestock feed trade is not strong. Uncertainty about supply and the feed value of beans, coupled with the need to have extra storage and processing (for pelleted rations), can make feed compounders reluctant to use beans as a primary protein source. In particular there has been no exploitation of the benefit of using native produced, traceable GM free products in animal diets. There is considerable scope to increase the amount of beans used in feed diets, but this requires all stakeholders to pursue this goal. There is also the possibility of supplying higher value human food export markets which currently accounts for 50% of UK bean production. Our realtively drought-free climate gives us the possibility of becoming a reliable producer of food grade beans provided bruchid beetle control is possible.

Oilseed rape can be sold into many markets. Without large-scale crushing facilities in Ireland, the use of OSR as whole crop in feed diets is the biggest market. Its high energy content and nutritional benefits make it an attractive feed ingredient. As a food oil for cooking or dressing, rape seed oil has a healthy fatty acid profile. In Ireland a number of smaller cold-pressed oil facilities have set up to supply branded native-produced traceable product for restaurant and home cooking use, and for export. There are many other potential uses for oilseed rape, but the need to export the whole crop does not give us a competitive advantage in many of these applications. However where fields without a history of oilseed crops are needed to produce specific fatty acid profile rape crops, Ireland may have an advantage. To grow the oilseed rape area we need to produce competitively for the higher volume markets and we need to support the development of high-value food markets with the developemnet of unique selling points based on oil quality and production standards.

Market development requires the active support and involvement of all stakeholders.

OSR and beans: Growing the markets

Dermot Forristal and John Spink
Teagasc CELUP
Oak Park Crops Research

Outline

- Background
- Key Break-Crops
- Beans: Markets, Potential, High value options
- OSR: Markets, Potential, High Value options
- **How to Grow the Market**

The Irish Agriculture and Food Development Authority

Background

- Irish Crop Production
  - Limited rotation
  - Few real break crop options
  - Impact on profitability and sustainability
- CROPQUEST confirmed the key break crops
  - Beans
  - Oilseed rape
  - Maize

(With speciality options: Lupins, Peas, Camelina)

The Irish Agriculture and Food Development Authority

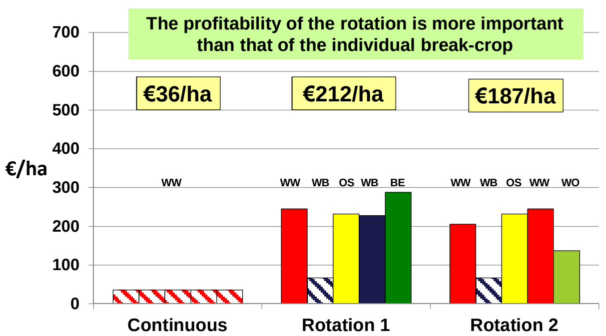
Break crops – the factors

- Individual Crop
  - Brings diversity in crops and markets
  - Crop economics
- Break Crop benefits
  - Disease break
  - Soil fertility
  - Soil structure

Benefits to other crops in the rotation

Must look at profitability of the rotation

Profitable rotations!

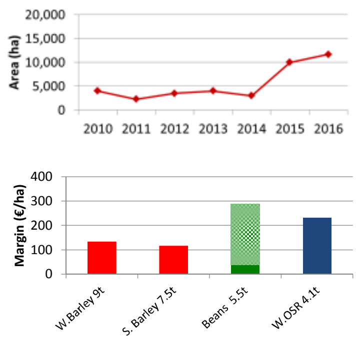


Break crop: Current concerns

- OSR: Area stable but not growing
- Beans: Area increasing, but aid-supported: Market / use concerns
- Both: Production concerns in our climate

Beans

- Area increasing
- Margin good, but support dependent
- Rotation benefits to following cereal
- Spreads workload
- Markets limited by not enough users placing in feed rations



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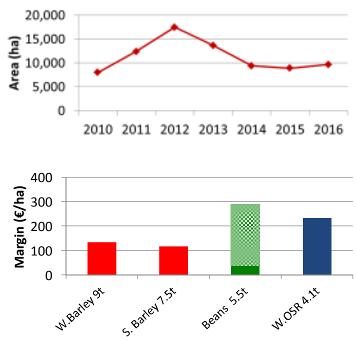
Oilseed rape

- Area stable
- Margin good; not support dependent
- Rotation benefits to following wheat
- Spreads workload
- Local markets limited



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Must develop markets

- To sustain / increase production over medium term
- To allow all involved to plan
- To reduce reliance on, and/or to complement, commodity markets by seeking higher value options
- **Chicken and egg!!**
  - Must have production to develop markets

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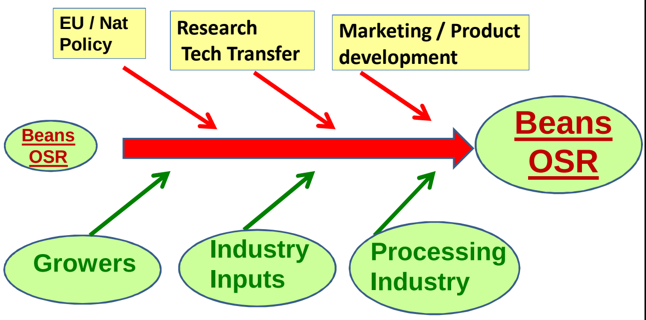
Sustained growth!



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Beans: Markets

- Primary Market: Protein and energy in feed rations
  - Significant EU deficit in feed protein
  - Ireland deficient in Protein and Starch
  - Importing approx 1.5 Mt of protein feeds (and 1.5 Mt of starch.)
  - Protein imports; exposed to:
    - World prices
    - Non- native sources of feed (GM)
    - Potential traceability issues

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Beans: Feed protein source

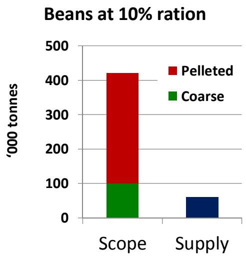
- Compare with Soya or more typically Maize distillers

	Beans	Maize Distillers *
Crude Protein (%)	**29.0**	**29.5**
Starch (%)	**44.7**	**9.3**
Fat/Oil (%)	**1.4**	**11.1**
M.E. (MJ/kg DM)	**13.3**	**14.2**
Cystine (% protein)	*1.2*	*2.0*
Lysine	*6.2*	*3.0*
Methionine	*0.8*	*2.0*

* variable depending on distilling process

Beans: Scope in Irish feeds

- Coarse rations: 1M t annually
  - At modest 10% inclusion:
    - 100,000 t of beans
  - 2016: 60,000t of beans produced
  - 60% of coarse ration scope
- Pelleted ration: 3.2M t annually
  - At 10% inclusion rate
  - 320,000t of beans
- At 10% inclusion for all feeds:
  - Currently only producing 14% of that !
  - Need 50,000 ha to exceed that
- So why is bean demand weak?



Weak bean demand: Why?

- Feed value not universally known
  - Compared to Soya and Maize Distillers
  - Anti-nutritional factors and inclusion levels
  - Impact of degradability of protein

- Traditionally : visual role in coarse rations.
- Supply has not been constant or large enough.
- An extra 'ingredient bin' needed to store it.
- More processing required for pelleted ration.
- **Little / No value placed on home-grown traceable feed**

High value bean market: Food

- Food in human diets:
  - Middle East, Mediterranean region
  - Suppliers: UK, France, Australia, Baltic
  - Scope to increase consumption (health)
- UK exports 50% of beans adding €30-€35/t premium
- Physical appearance important
  - Practically free from Bruchid beetle damage
  - Big beans >9mm needed - drought challenge
  - Pale colour and skin finish (variety, but also weather)

Beans – Future development

- **Animal feed - Increase use in rations:**
  - Increase supply and produce consistently
  - Value native production and traceable credentials – branded product?
  - But must produce competitively
- **Food market – develop carefully**
  - Possibilities for export (but avoid damaging the developing feed industry)
  - Legume consumption may grow

Oilseed Rape

Oilseed rape: Market estimates

- Whole crop feed > 80%
- Cold pressed food grade oil < 10%
- Export for crushing
- Other potential niche markets
  - HOLL
  - HEAR
  - Varieties with specific fatty acid profiles
  - Fertiliser binder etc

(Export for crushing and other potential niche markets: <10%)

Whole oilseed rape in feed

21% protein 10% fibre 46% oil

- Metabolisable energy (M.E.)
  - Ruminants: 20.3 MJ/kgDM
  - Pigs: 22.8 MJ/kgDM
  - Poultry: 16.8 MJ/kgDM
  - Processing (grinding, micronisation):improve utilisation
  - Can reduce Methane production and alter milk F.A.
  - Inclusion rates: Up to 10% of diet

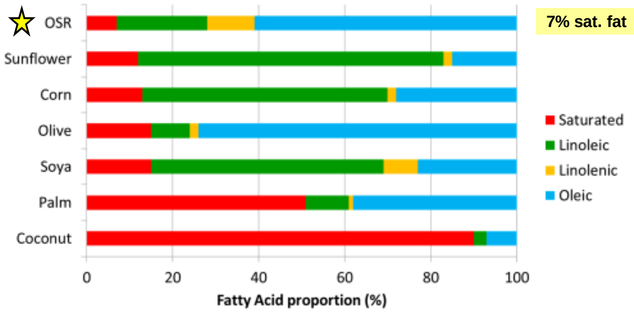
OSR: Food markets

- Food grade oils

  We import 200,000t of oils
  - Palm oil: 89,000t
  - Soya oil: 44,000t
  - Rape oil: 41,000t
  - Sunflower: 13,000

- OSR oil:
  - Healthy fatty acid profile
  - Specific F.A. profiles for specific markets (e.g. HOLL)
  - Cold pressed extraction for high-value branded bottled oils
  - Export market for high yield extraction for high volume markets

OSR: Fatty acid profile vs others



Source: HGCA

Cold-pressed oil

- Approx 9 producers; small but 5 -10% of OSR
- High-Value, branded, native traceable crop
- Good Fatty acid profile
- Suitable for dressing and cooking
- Benefitting from interest in cooking and healthy foods
- How can we build on this

Other uses for OSR

- HOLL: High Oleic and Low Linolenic and Linoleic F.A.s.
  - For Large scale cooking / deep frying.
- HEAR: High Erucic acid OSR: only for industrial use
  - Used in production of polymers.
- Other OSR uses
  - Biofuels
  - Lubricants
  - Binding agent in Fertiliser
  - Surface coatings/inks
  - Feed uses for Oilseed rape cake

OSR – Future development

- **Animal feed will continue to play an important role**.
  - Competitive production of high yielding crops vital.
- **Export for high volume crushing**
  - Discounted option for extra production
  - May be an option for specific oil qualities handled on a batch basis
- **Cold-pressed oil**
  - Important high-value option worth developing
  - Needs production and marketing support
  - Would benefit from USP (quality and/or traceability aspect)
  - Develop Irish brand to underpin the individual brands
  - Scope for varieties with unique FA profiles (HOLL)
- **Other oils** with specific FA profiles

Conclusions

- Beans and OSR have most potential
- Their benefit in rotations must be considered
- Progress must be underpinned by industry wide approach:
  - Active development of local markets
  - Continuity of supply critical
  - Contract growing
  - Development of high value export markets

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Teagasc break crop research

Bean Agronomy

- Funding
  - IFA grain levy
  - Teagasc
  - DAFM (2017)
- Collaborators
  - UCD
  - University of Reading
  - University of Nottingham

OSR Agronomy + Oil Quality

- Funding
  - DAFM (2017)
  - Teagasc
- Collaborators
  - WIT
  - ADAS

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Ballykilcavan farm: Diversification and risk management

David Walsh-Kemmis
Farmer, Laois

SUMMARY

I have been farming 160 hectares of tillage at Ballykilcavan, Stradbally, Co. Laois since 2004. The main crop is malting barley, along with gluten-free and feed oats and beans.

Unlike my previous work in computing, I realised that many things in farming cannot be controlled, in particular the weather and the market price. Instead, it is important to control the factors you can control:

- Costs: Efficient use of inputs; examining machinery costs; looking at poorly performing areas of fields.
- Crop choice: Growing crops that attract a premium and investigating alternative crops that suit each individual farm and field.
- Crop marketing: Ensuring you get the best possible price for your crops over the course of the year.
- Other schemes: Making use of GLAS and other schemes.
- Diversification: Looking to see if the farm can support an alternative source of revenue.

In 2010, I started the process of small changes to my farming setup by reducing the amount of commodity feed grains and growing more crops that attract a premium and that the market is looking for. This meant increasing my malting barley area and starting to grow gluten-free oats. I have also looked for alternative crops that might suit my light soils and have experimented with miscanthus, oilseed rape and lupins. In 2016 I took part in the early Glanbia trials of growing quinoa in Ireland.

I believe in forward selling 60% of all my crops throughout the year, and making full use of the hedging mechanism for malting barley. Whilst this meant I missed the top of the market in the high price year of 2012 by €20/t, I have gained by €15-20/t in every subsequent year compared to the green price at harvest.

I grow 32 hectares of cover crops under GLAS, and also put in cover crops on all my remaining spring cereal ground. These crops are grazed by sheep later in the year and the income from the sheep helps to cover the cost of the seed as well as easing management of the crop residue.

I am also diversifying my business by opening an on-farm craft brewery (Ballykilcavan Brewery) that will source all its barley from the farm. This adds value to an existing farm product, makes use of an old empty stone farmyard and will provide an alternative revenue stream to secure a viable future for the farm.

BALLYKILCAVAN FARM

DIVERSIFICATION AND RISK MANAGEMENT

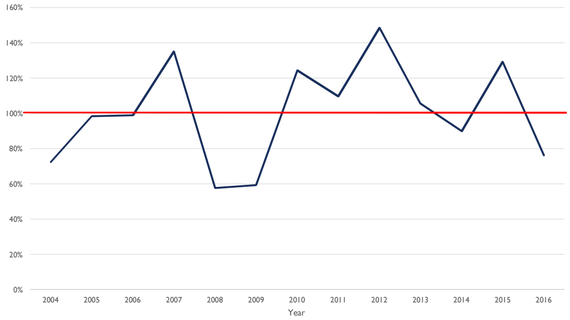
BALLYKILCAVAN FARM

- 163 ha of tillage
- 90 ha of malting barley
- 18 ha of gluten free oats
- 32 ha of feed oats
- 10 ha of beans
- 5 ha of lupins
- 8 ha of quinoa

MY BACKGROUND

- Farming since 2004
- Qualification in computer science
- Computers: predictable, controllable
- Farming: unpredictable, much less control

PERCENTAGE OF SFP RETAINED



PREMIUM CROPS – GLUTEN FREE OATS

- Gluten free oats: best margin
- More paperwork, more fieldwork
- Harvested and drawn by Glanbia

PREMIUM CROPS – MALTING BARLEY

- €30 a tonne over feed
- Yield potential?
- Specification: Protein, skinning

ALTERNATIVE CROPS – LUPINS

- First and last time growing in 2016
- Blue (Iris) – Harvested 27/09, 3.6 t/ha
- White (Dieta) – Harvested 20/10, 5 t/ha
- Good quality, but too late harvesting

ALTERNATIVE CROPS – QUINOA

- Trial for Glanbia
- Two varieties: Harvested 26/08 and 28/09
- Excellent potential: easy management, good quality, good yield

DRYING AND FORWARD SELLING

- Drying from 2004 to 2014
- Forward selling since 2012

- 2012: Lost €20 a tonne
- 2013: Gained €20 a tonne
- 2014: Gained €15 a tonne
- 2015: Gained €20 a tonne
- 2016: Gained €15 a tonne
- Overall: Up by about €30,000

GLAS - COVER CROP ESTABLISHMENT

- 32 hectares for GLAS – fodder rape and leafy turnip.
- Other fields: beans (60 - 80 kg/ha), tillage radish (4kg/ha), phacelia (1 kg/ha)
- 2 pass: disc + pneumatic seeder, flat roller

GRAZING OF COVER CROPS

- Grazed by sheep
- No roundup, no topping, improve SOM
- Nitrogen more readily available
- Covers cost of seed
- Account for N and P, Record 4

DIVERSIFICATION – BALLYKILCAVAN BREWERY

- Add value to existing farm produce
- Get margin for myself, don't hand it over
- Use for empty old stone buildings

IRISH MALT FOR IRISH BEER

- All grain (barley, oats, wheat, rye) will be grown on-farm.
- Base malts created by Minch Malt in Athy.
- Specialty malts micro-malted and roasted
- Provenance, Quality, Terroir.

WHAT IS GOING TO KEEP MY FARM VIABLE?

BALLYKILCAVAN BREWERY

- Regularly examine the business
- Alternative and premium crops
- Crop marketing
- Diversification

The maize guide and inter-farm trading

Kevin Cunningham
Chairman of Maize Industry Group & DLF Business Manager

SUMMARY

The Maize Industry Group was formed in 2015 to look at ways to provide the most up-to-date information for those considering growing maize in Ireland as an alternative forage for feeding dairy and beef animals but also as a break crop for tillage farmers. Currently there are 10-12,000 ha of maize being grown by Irish farmers for forage. Maize silage can be used across a range of farm enterprises including buffer feeding in spring herds, winter milk production systems and beef production systems.

The cost of producing maize silage is strongly related to its yield and its value in producing a litre of milk or kilo of meat is dependent on effective conservation and level of inclusion in diets. This guide therefore, brings together the combined expertise of Teagasc, DAFM, UCD, farmers and industry experts on best practice in growing, conserving and feeding maize silage. As dairy enterprises expand contract growing of maize silage by tillage farmers is an option to increase forage supply, a maize silage contract template is also included to allow the farm-to-farm trading of maize silage, which values both the yield and quality of the crop produced.

The Maize Guide & Inter-farm Trading

KEVIN CUNNINGHAM

CHAIRMAN OF MAIZE INDUSTRY GROUP & DLF BUSINESS MANAGER

Acknowledgements

Kevin Cunningham, DLF (Chairperson)	Eva Lewis, Teagasc
Gordon Shine, Shine Agri.	John O'Donnell, Tillage farmer
Cara Mc Aodain, DAFM	Noel McCall, Dairy farmer
Mark Hosford, SFFS	Dermot Forristal, Teagasc
Richie Hackett, Teagasc	Steven Kildea, Teagasc
Tim O'Donovan, Seedtech	Dave Barry, Goldcrop
Bridget Lynch, UCD	Ken Daniels, Goldcrop
Joe Patton Teagasc	Willie Tanner, Maize seed merchant
Alan Kelly UCD	Joseph Lynch, Teagasc

Maize Industry Group

- Set up in September 2015
- Looking at the challenges with maize silage growing/feeding in Ireland
- Over 15 people involved across trade, Teagasc, UCD, DAFM and farmers
- Identified key areas for improvement
  1. Knowledge of growing
  2. Knowledge of feeding
  3. Knowledge of quality
  4. Contract growing/purchasing

1. Knowledge of Growing

Economics

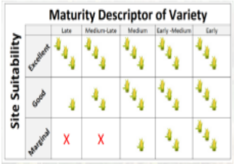
•Cost of growing maize is €126 per 1,000 UFLs or €100 per tonne DM

•Average 3 year yield is 17tn DM per hectare in official trials

•Total variable costs are €1,713 per hectare

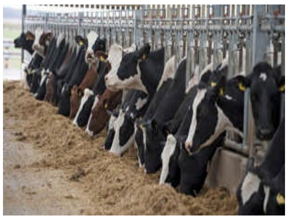
Variety Selection

- Variety is the single biggest factor for maize growing successfully
- DAFM RL identifies robust varieties for Ireland
- Maturity descriptor based on DM % of varieties indicates maturity



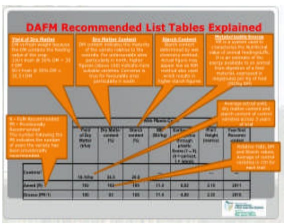
2. Knowledge of Feeding

1. **Buffer feeding** spring calving herds – either ex a silage pit or tubing
2. **Indoor feeding** winter milk herds – maize increases overall feed intake when fed and is cost competitive
3. **Beef production systems** – decreases finishing time and is cheaper than other forages especially grass silage



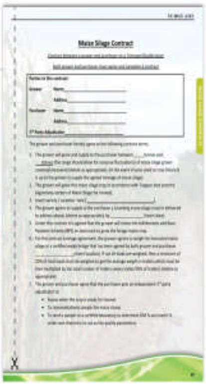
3. Knowledge of Quality

- Maize under cover has a **higher & consistent yield and starch**
- **Selecting the correct variety** will help achieve higher yield and quality
- Maize quality is relatively **consistent when correct varieties** are chosen



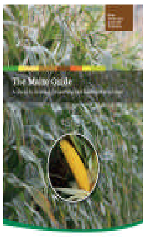
4. Maize Contracts

- **Need for written contracts** – versus gentleman's agreement
- Contracts are based on **yield** and **quality**
- A base price is agreed and **plus** or **minus** then depending on Starch and DM result
- **Third party adjudicator** important from both grower and purchaser perspective



Maize Silage Contract

Thank you for your time



www.teagasc.ie/maize-guide

Fungicide resistance update: wheat and barley

Steven Kildea
Teagasc, CELUP, Oak Park

SUMMARY

Controlling diseases in Irish wheat and barley crops is essential to maximising final yields. To achieve these goals control programmes integrating all available measures, including varietal choice, agronomic practices and fungicide applications must be utilised. Whilst all measures should be equally balanced and effective, given the immense disease pressures often experienced in Irish cereal crops fungicides are often the most important and relied upon to provide disease control. This reliance does however come at a cost, with the development of fungicide resistance now a major threat to the sustainability of cereal production throughout Ireland.

Septoria tritici blotch continues to be the most economically destructive disease of Irish wheat crops. With the exception of the multisite fungicides chlorothalonil and folpet, resistance to all the other major fungicide groups used for control are now present in the Irish population. In the case of the QoIs, resistance is complete and present at extremely high levels, varying degrees of resistance are present to the azoles, and resistance to the SDHI has been detected and is likely to increase with continued use. In the barley net blotch pathogen moderate levels of resistance have been detected to the QoIs and SDHIs although the frequency continues to be low, complete resistance to the QoIs has also been detected in a small number of Rhynchosporium populations, whilst QoI resistance is present at extremely high levels in Ramularia populations, with mutations conferring moderate resistances also reported in a small number of cases. QoI resistance is also widespread in the Irish Microdochium spp. responsible for ear blight of wheat and barley

Given the importance of fungicides to cereal production in Ireland, all available measures that can help reduce selection for resistance must be implemented. Most notably these include using fungicides only when required, i.e. where their application will provide a proven benefit to disease control and subsequent yield, at the lowest doses required to achieve control and always in mixture with an effective partner from an alternative mode of action. As not all actives within a specific mode of action, such as the azoles or SDHIs, select for resistance in the same way. It is useful to restrict the number of applications of individual actives by alternating the different components of a mixture between treatments.

Fungicide resistance update: wheat and barley

Steven Kildea
Teagasc CELUP
Oak Park Crops Research

What is fungicide resistance

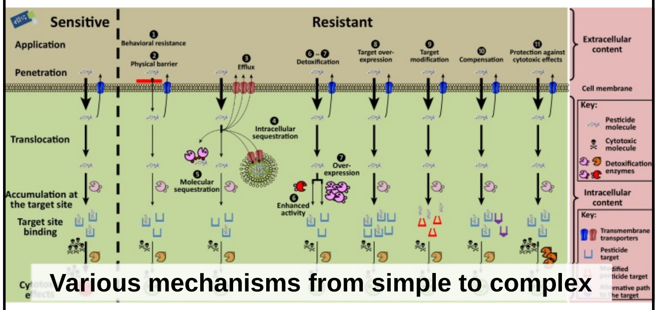
"An acquired, heritable reduction in the sensitivity of a fungus to a specific anti-fungal agent (or fungicide)"

Fungicide Resistance Action Committee

"The spray doesn't work as well as it did!"

The Irish Agriculture and Food Development Authority

What causes pesticide resistance?



Various mechanisms from simple to complex

Trends in Plant Science 2016 21, 834-853DOI: (10.1016/j.tplants.2016.06.006)

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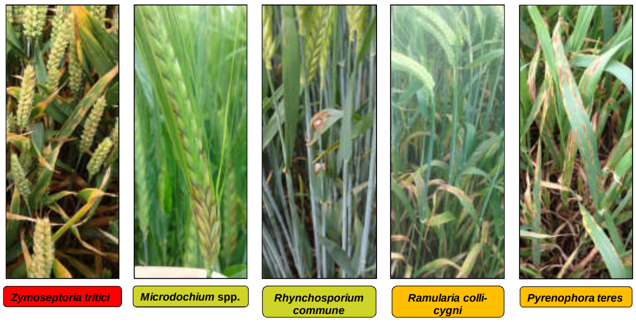
In cereal pathogens…

- Target site mutations
- Overexpression of target site
- Efflux of fungicide from pathogen

Current issues in Irish cereals



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Septoria

- Most destructive disease of Irish wheat crops
- Control almost entirely reliant on fungicides
- Resistance to azoles & SDHIs now present in Irish populations – CTL essential
- Need to shift reliance from fungicides

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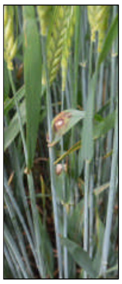
Microdochium spp. (ear blight)

- Part of the Fusarium Head Blight complex of wheat and barley
- Major problem in cool wet conditions - 2012
- Resistance to QoIs (strobs) now widespread in Irish population
- Control now dependent on prothioconazole – but timing essential

Rhynchosporium



- Most prevalent foliar disease of Irish barley crops
- Diverse range of actives available for control
- Resistance to QoIs now present in Irish population
- Differences in azole activity impacting field activity – prothioconazole not affected

Ramularia

- Generally later in season
- Resistance to major systemic fungicides present in mainland Europe
- QoI resistance widespread in Irish populations, monitoring to others ongoing
- Addition of CTL at final spray essential

Net blotch

- Can impose significant yield penalties
- Resistance present to QoIs (F129L & G137R), although impacts on efficacy dependent on active
- Strains with moderate SDHI resistance detected in Irish population
- Widespread SDHI resistance (moderate) in mainland Europe

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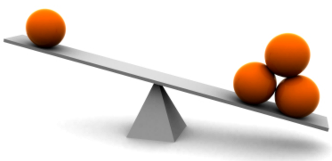
Slowing the slide towards resistance

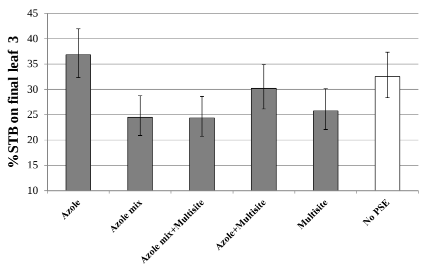


Balancing disease control and resistance management

The Irish Agriculture and Food Development Authority

Slowing the slide towards resistance

A) Only use when required – must provide benefit



Azole T0

Disease Control? No Yield Benefit

⇩

Resistance selection

⇩

Poorer control later in season

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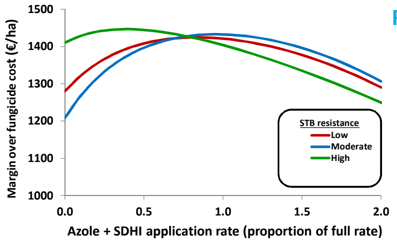
Slowing the slide towards resistance

B) Use the lowest dose required



Reduce Need for Fungicides

Increased Dose

Increased Resistance

See Joseph Lynch

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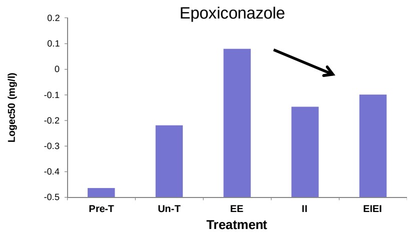
Slowing the slide towards resistance

C) Mix different modes of action



e.g. SDHIs reduce azole selection

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Conclusions

- Fungicide resistance is an increasing threat to Irish cereal production
- Varying levels of resistance present in Irish pathogen populations
- Measures to reduce reliance on fungicides will also help reduce resistance selection

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Date for the diary

Septoria Conference 22nd March, Dunboyne Castle, Co. Meath

Fungicide Resistance
- Can we regain ground lost?

Varietal Resistance
- Maximising resistance available

Agronomic Control
- Can cultural control do more?

Acknowledgements

Dr. Hilda Dooley
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Dr. Joseph Lynch
Dr. Sinead Phelan
Dr. Henry Criessen

Advisory Service

Barley disease management: Optimising fungicide timings and rates

Liz Glynn and Jim Grace
Teagasc, CELUP, Oak Park

SUMMARY

Yield in barley is determined by three factors, number of ears per m^2, number of grains per ear and the average grain weight. Unlike wheat, good yields in barley are determined by grain number per m^2. Therefore early crop management becomes key to maintaining tiller numbers to maximise the yield potential of the crop.

Keeping this in mind, fungicides should be timed to ensure maximum tiller and green leaf retention early in the season. An extensive series of fungicide timing trials were carried out on both winter and spring barley. The winter barley trials were carried out from 2010-2013, in both Carlow and Cork, looking at 5 spray timings in all possible combinations. The study showed that the key timings to get a response from fungicides were at mid-late tillering (GS<GS30), stem extension (GS31/32) and awn emergence (GS39/49). If the final application was delayed until ear emergence (GS59) there was a yield penalty. This highlights the need to protect the awns as they emerge and not to wait until the head is fully out. There was also no significant response from an autumn application. In spring the study was carried out from 2012-2014, on different varieties in counties Carlow, Kilkenny and Wexford, with varying levels of disease pressure over the 3 seasons, looking at the last 4 spray timings used in the winter barley trials, in all combinations. Traditionally spring barley was sprayed at stem extension and ear emergence. The study showed that the greatest response to fungicides was achieved at mid-late tillering and awn emergence. It was found that by delaying the first application until stem extension and the second application until ear emergence, there was a yield penalty of 0.5t/ha. The traditional programme yielded 7.2t/ha, while the mid-late tillering and awn emergence combination yielded 7.7t/ha.

The success of any fungicide programme is based on a collection a factors, some under our control and some not. The current weather pattern, disease levels present and most importantly the yield potential of the crop, need to be assessed prior to application. Fungicide efficacy on both winter and spring barley has been consistent in recent years, with good levels of control being achieved with the main fungicide groups, SDHI's, triazoles and strobilurins. The inclusion of Chlorothalonil to the later timing is beneficial for the control of Ramularia. As there are broad range of products available for use on barley, it's important that these are utilised, firstly for good disease control and secondly as part of a resistance management strategy, by not over relying on individual actives throughout the programme. A minimum of 2 actives should be used at each application, with a mildewcide added if required. From analysis of numerous trials looking at disease control, yield and margin, on a wide range of products and sequences of different products at variable rates no more than half rate of any individual product is required. The fungicide spend should be spread equally across the programme.

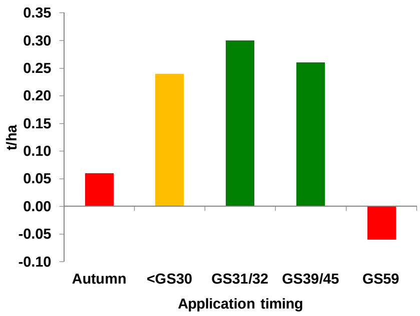
Barley disease management: Optimising fungicide timings and rates

Liz Glynn and Jim Grace
Teagasc CELUP
Oak Park Crops Research

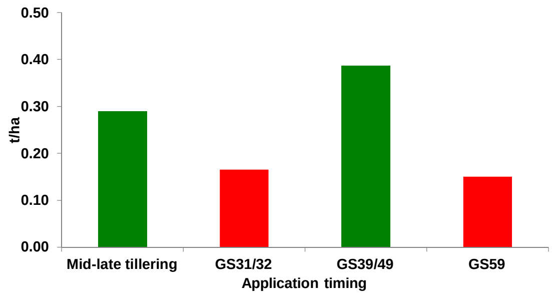
Outline

- Winter and spring barley
- Timing of application
- Product choice
- Optimum rates
- Current disease issues

Timing of application - Winter



Timing of application - Spring



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Winter barley dose response

- Variety: Saffron (2014) Cassia (2015,2016)
- 3 site seasons (2014-2016)
- Tipperary (2014), Oak Park (2015,2016)
- ¼, ½, full & double rate
- 1 application – GS31/32

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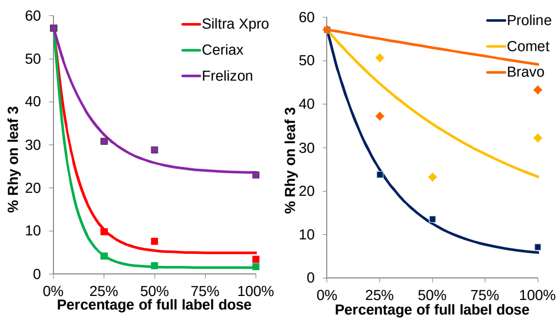
2016 curative performance



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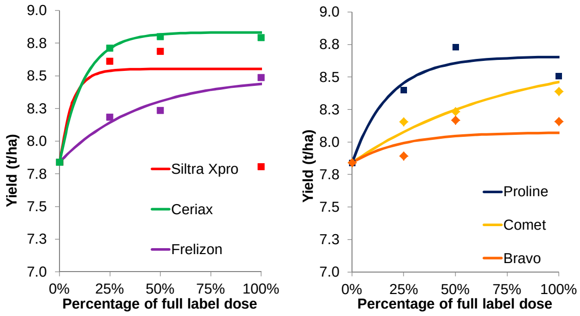
2016 yield



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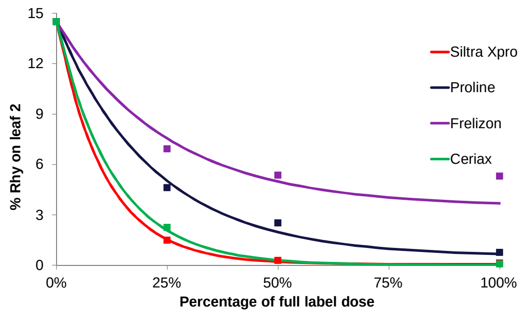
3 year protectant performance



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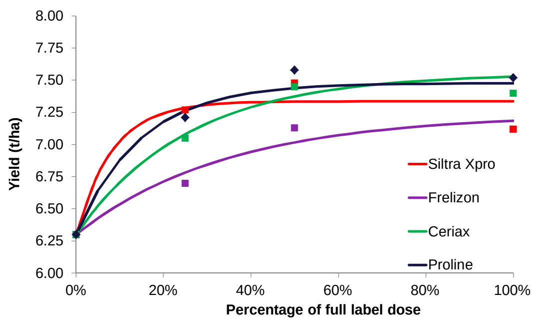
3 year yield



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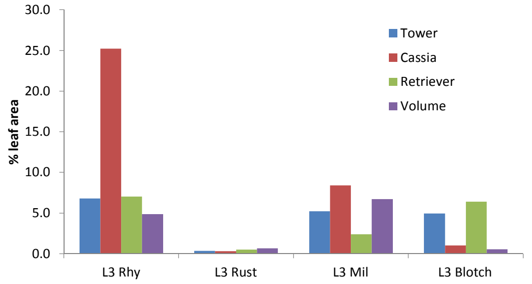
Winter barley fungicide x variety trial

- 4 varieties – Cassia (Sn), Retriever (Sr), Volume (Rr) & Tower (Rn)
  (S: susceptible, R: resistant, r: responsive, n: non-responsive)
- 3 spray programme – Proline + Jenton
- ¼, ½, ¾ and full of each product
- 2 sites – Oak Park & Kildalton
- Repeated in 2017

Low disease pressure in most varieties



Assessed 1st June

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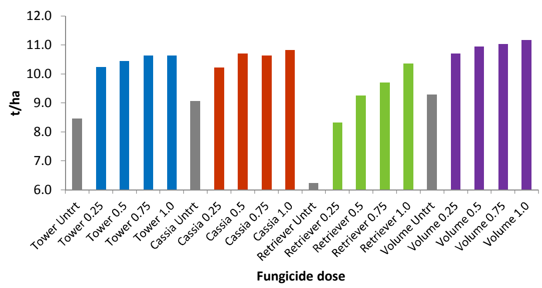
No significant increase in yield beyond half rate



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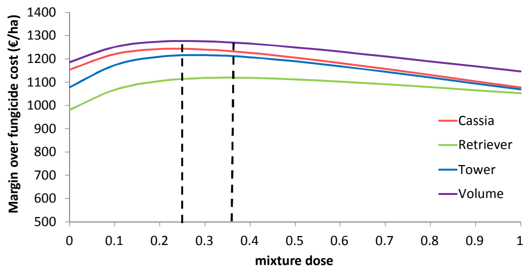
Optimum rate of ¼ to ⅓ dose of each mix partner



Blotching in winter barley

- Evident in a number of crops in 2016
- Present on tillers in January 2017
- 1 trial in Knockbeg on cv. Retriever - 2016

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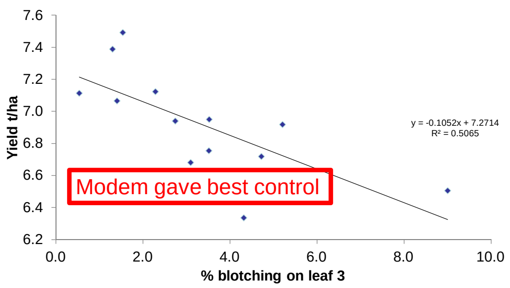
Blotching effect on yield



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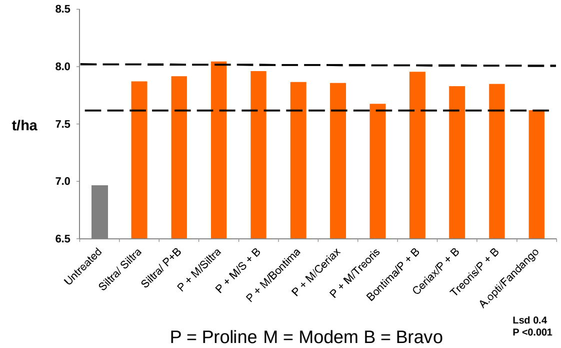
Spring barley programmes trial

- Variety: Propino (2015, 2016), SY taberna (2015)
- 5 site seasons (2015-2016)
- Oak Park (2015, 2016), Kildalton (2016), Wicklow (2015)
- 2 applications (Tillering & awn emergence)
- Fungicide spend: €40 - €100/ha

No significant difference between programmes



P = Proline M = Modem B = Bravo

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Product choice

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Winter barley

	Tillering GS <30	Stem extension GS 31/32	Awn emergence GS 39/45
Target diseases	• Rhynchosporium • Net Blotch • (Mildew) • (Rust)	• Rhynchosporium • Net Blotch • (Mildew) • (Rust)	• Rhynchosporium • Net Blotch • Ramularia • (Mildew) • (Rust)
Programme	**Mixtures** SDHI/azole/Strob/multisite Mildewicide where required	**Mixtures** SDHI/azole/Strob/multisite Mildewicide where required	**Mixtures** SDHI/azole/Strob Chlorothalonil needed here for Ramularia control Mildewicide where required

Spring barley

	Tillering GS <30	Awn emergence GS 39/49
Target diseases	• Rhynchosporium • Net Blotch • (Mildew) • (Rust)	• Rhynchosporium • Net Blotch • Ramularia • (Mildew) • (Rust)
Programme	**Mixtures** SDHI/azole/Strob/multisite Mildewicide where required	**Mixtures** SDHI/azole/Strob Chlorothalonil needed here for Ramularia control Mildewicide where required

Barley guidelines for 2017

- Protect tillers
- Use a mixture of at least 2 actives
- No more than half rates needed
- Equal spend at each timing
- Don’t delay final application until ear emergence


Thank you for listening
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The value of variety choice in cereals

Joseph Lynch, Deirdre Doyle and John Spink
Teagasc, CELUP, Oak Park

Ethel White, Lisa Black and Sharon Spratt
AFBI, Crossnacreevy

SUMMARY

Variety selection is one of the first crop management decisions made during the season and has the potential to affect the crops' responses to a range ofsubsequent crop inputs. In order to aid this decision, lists detailing varieties recommended for growth in Ireland, and their scores for range of characteristics that affect cereal growth, are published by DAFM. However, it is not well known if the yield of varieties with contrasting scores on the recommended lists respond differently to corresponding crop inputs. If these responses consistently differed to a significant degree, it may allow for reductions in the risk associated with below-optimum applications of inputs, or a reduction in the optimum rate. Studies were conducted to evaluate whether varieties than contrasted in important variety characteristics (spring barley: *Rhynchosporium* resistance, lodging resistance; whinter wheat: Septoria tritici blotch resistance) responded differently to a range of corresponding crop inputs.

While the severity of Septoria observed on winter wheat varieties evaluated generally corresponded with their Septoria resistance score, the yield response of the moderate-score variety to increased fungicide rate was much greater than the low-score variety. This resulted in similar optimum rates of fungicide between the contrasting varieties, and a lower untreated yield for the moderate-score variety than the low-score variety, on average across five site-seasons. Despite this, when a variety with a high septoria resistance score (8 out of 9) was evaluated, it incurred lower disease severity, had a lower optimum fungicide rate and had a higher untreated yield than the other varieties with lower scores. This indicates that septoria resistance scores alone do not reflect the risk to yield and margin loss of below-optimum applications of fungicide for the current range of varieties recommended. The disease severity or yield response of spring barley varieties that contrasted in *Rhynchosporium* resistance scores to fungicide rate did not significantly differ in seasons of high or low disease pressure. The yield of spring barley varieties that contrasted in lodging resistance scores responded similarly to increased nitrogen application rate at five of the six evaluated site-seasons. However, at one site with very high lodging pressure (Belfast 2014), a significant difference was observed in the yield loss from above optimum N application rates, with the variety selected for high lodging resistance score incurring lower yield losses than the other, lower-scored, varieties evaluated. In summary, resistance scores reported on recommended lists do not currently allow for the confident alterations of crop inputs to reduce input costs, and do not alone provide an indication of risk from yield loss in extremely challenged crops, however there is evidence that this could be achieved if varieties that confer stronger resistance to these factors became available in the future.

The value of variety choice in cereals

Joseph Lynch, Deirdre Doyle and John Spink
Teagasc CELUP
Oak Park Crops Research

Ethel White, Lisa Black and Sharon Spratt
AFBI, Crossnacreevy

Variety interacts with everything

- Variety choice
- Cultivation type
- Sowing date
- Seed treatment
- Seeding rate
- Weed control
- Pest control
- Organic fertiliser applications
- Inorganic fertiliser applications
- Disease control
- PGR applications
- Harvest date
- Straw harvest/cultivation

The recommended lists

WINTER WHEAT 2017

AGRONOMIC & QUALITY CHARACTERISTICS*	RECOMMENDED				PROVISIONALLY RECOMMENDED		
	AVATAR	JB DIEGO	KWS LILI	KWS LUMOS	COSTELLO	GARRUS	ROCKEFELLER
Relative Yield ◆	**100**	**100**	**100**	**98**	**99**	**102**	**98**
Straw Height (cm)	82.9	80.1	72.5	75.6	74.3	76.9	91.5
Resistance to lodging	7	6	8	8	(8)	(7)	(5)
Straw breakdown	7	7	7	7	(7)	(6)	(7)
Earliness of ripening	5	6	4	7	(6)	(5)	(4)
Resistance to:							
Mildew	5	6	8	7	(8)	(8)	(8)
Septoria spp.	4	5	6	5	(5)	(6)	(7)
Yellow rust	7	7	6	7	(8)	(5)	(8)
Fusarium ear blight	6	6	4	5	(7)	(6)	(7)
Sprouting	5	7	6	7	(8)	(4)	(7)
Quality:							
Grain Protein % (15%MC)	9.4	9.8	9.4	10.0	10.2	9.9	9.6
Hagberg Falling No.◆	258	305	297	342	356	125	293
1000 grain weight (g)	51.0	51.9	47.0	46.5	50.5	48.7	49.5
Hectolitre weight (kg/hl)	77.8	77.4	76.5	78.1	79.9	76.1	77.5
Market +	F	F	Br	Br	F	F	F
Year First Listed	**2013**	**2010**	**2016**	**2014**	**2017**	**2017**	**2017**

Approaches to cereal variety choice

Choosing…

1. …anything from recommended list
2. …a high yielder from the recommended list
3. …based on characteristics on a recommended list

Questions we wanted to ask:

Do varieties that have different ratings for a characteristic…

a. …consistently differ across sites and seasons?

b. …have different optimum rates of a corresponding input?

c. …differ in their risk of margin loss in challenging years?

Trials overview

- 37 trials conducted in total (19 for winter wheat, 18 for spring barley).
- 6 variety characteristic ratings studied:

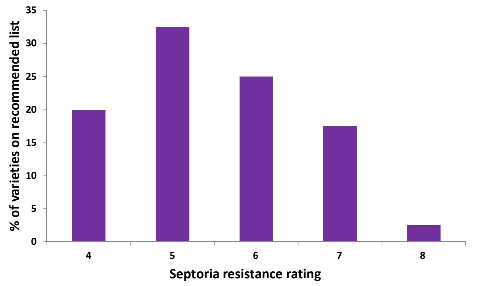
Winter wheat

- Septoria resistance
- Lodging resistance
- Eyespot resistance
- Hectolitre weight

Spring Barley

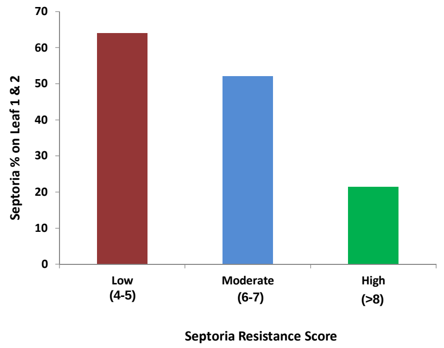
- Rhynchosporium resistance
- Lodging resistance

Winter wheat– Septoria resistance

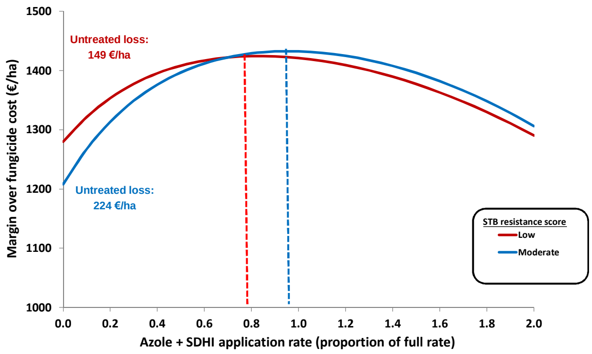


- Range on recommended list from 2012-2016 was 4 - 8

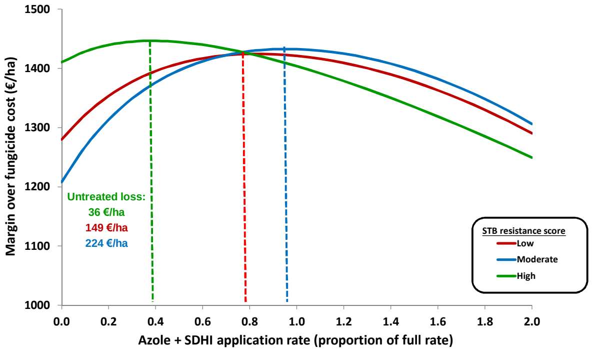
Untreated crops at GS71



Margin response to fungicide rate – 5 sites



Margin response to fungicide rate – 5 sites



Winter wheat– Septoria resistance

Do varieties that have different Septoria ratings consistently…

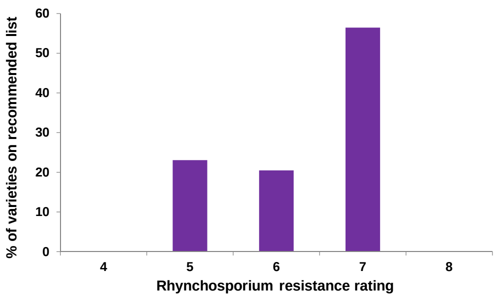
a. …differ across sites and seasons?
YES

b. …have different optimum rates of a corresponding input?
NOT WITHIN THE CURRENT RANGE

c. …differ in their risk of margin loss in challenging years?
NOT WITHIN THE CURRENT RANGE

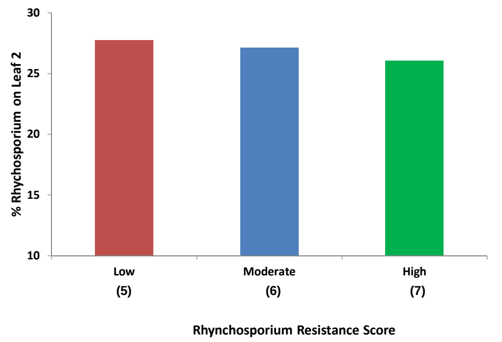
…. untreated yields seem to provide better indications of these

Spring barley – Rhynchosporium resistance



- Range on recommended list from 2012-2016 was 5 - 7

Untreated crops at GS71 - 2014



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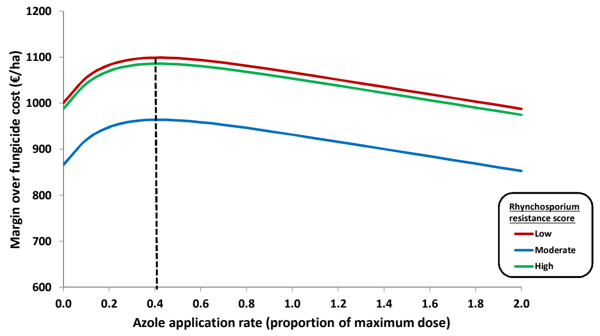
Margin response to fungicide rate - 2014



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Spring barley – Rhynchosporium resistance

Do varieties that have different Rhynchosporium ratings consistently…

a. …differ across sites and seasons?
   DIFFERENCES WERE SMALL ON AVERAGE

b. …have different optimum rates of a corresponding input?
   NOT WITHIN THE CURRENT RANGE

c. …differ in their risk of margin loss in challenging years?
   NOT WITHIN THE CURRENT RANGE

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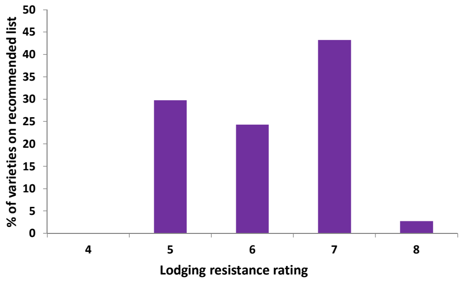
Spring barley – Lodging resistance

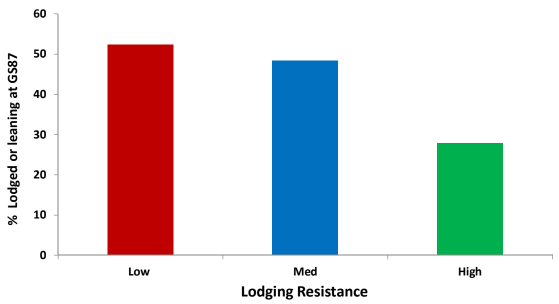


- Range on recommended list from 2012-2016 was 5 - 8

The Irish Agriculture and Food Development Authority

Spring barley – Lodging resistance

Average of 6 site-seasons, 2014-2016



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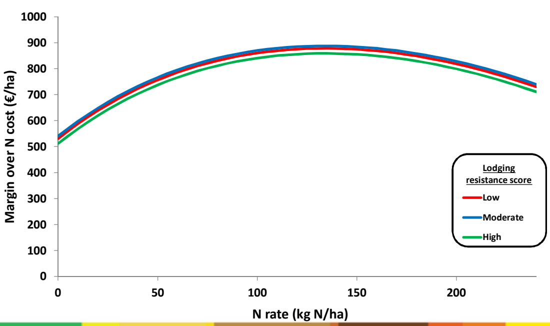
Spring barley – Lodging resistance

Average of 5 out of 6 site-seasons, 2014-2016



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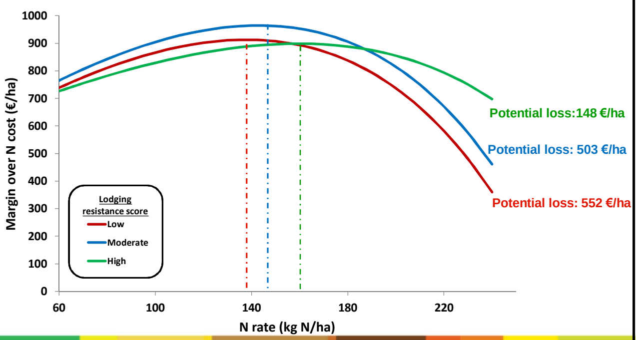
Spring barley – Lodging

1 site: Belfast 2014



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Spring barley – Lodging resistance

Do varieties that have different lodging resistance ratings consistently…

a. …differ across sites and seasons?
YES…when pressure is high

b. …have different optimum rates of a corresponding input?
YES…but only in a very challenging season

c. …differ in their risk of margin loss in challenging years?
YES…but only in a very challenging season

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Value of variety choice

- Disease/lodging resistance scores do reflect disease and lodging severity
- Recommended lists exclude very poor varieties
- Current high resistance scores (~7) don't confer lower yield risk/optimum rate
- Reduced risk and rates possible for varieties with higher resistance (8&9)
- Treated yield scores have minor value without untreated/challenged yields

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- Steven Kildea
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- Crossnacreevy Farm staff
- Student Interns

- **DAFM Stimulus funding (CIVYL)**

Grass weed herbicide resistance

Rónan Byrne
Teagasc, CELUP, Oak Park

SUMMARY

Weed control is an important aspect of any crop management plan. Herbicides are an important component of the weed control programme, however, as with most plant protection products with continued use, the risk of herbicide resistance evolving increases. The most problematic grass weeds on Irish tillage farms are wild oats, sterile and meadow brome, canary grass and black grass. The key to "winning the battle" against these species is to understand their agro-ecology and target them at stages in their life cycle where they are weakest.

Edward Salisbury said, as far back as 1961, "Established agricultural practices are the first line of defence against many evils, whilst herbicides should be regarded as a supplement to, not a substitute for, good husbandry" and this rings true today. While herbicides form a vital part of any weed control program, they must be considered a tool, not the whole toolbox.

Vital to maintaining the efficacy of this toolbox is to understand the extent to which infestations of these weeds occur on Irish farms. While brome, wild oats and canary grass are commonplace throughout the country, a key component of this project is observing for outbreaks of herbicide resistant black grass and monitoring whether or not the aforementioned species are becoming resistant to the herbicides commonly used by growers. Intitial screens using; propaquizafop, pinoxaden, cycloxydim and meso/iodosulfuron have identified resistant populations of both blackgrass and wild oats. We must learn from what has happened in the UK, where herbicide resistance is common and grass weeds inflict huge economic damage on the tillage farmers, with 21% of growers spending more than €120/ha for their control.

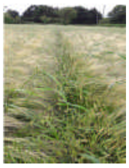
Furthermore we aim to determine links between certain agronomic practices and the development of severe weed problems. This may be the use of minimum tillage, the length of crop rotation, date of sowing, crop seed rates and row widths etc. Establishing links between these practices will allow us to manage weeds while they exist in small populations in the field. It cannot be stressed enough that the more weed plants there are in the field, the more chances that weed has to become resistant to herbicides. Reducing the number of "tickets" the weed species has in the genetic "lottery", greatly reduces the risk of the onset of resistance.

Grass weed herbicide resistance

Rónan Byrne
Teagasc CELUP
Oak Park Crops Research

What is the problem?






What grass weeds are most prevalent in Ireland?

- Wild oats, the bromes and canary grass amongst others
- Populations of black grass are on the increase
- We rely heavily on herbicides for weed control
- Herbicide resistance is inevitable with their continued use
- Resistant weeds are significantly more difficult, and more expensive to control

What we've done so far




- Samples from the field screened for resistance to; propaquizafop, pinoxaden, cycloxydim and meso/iodosulfuron
- Sprayed plants are monitored closely and compared to unsprayed controls
- Blackgrass and wild oats found which appear to be resistant to 1 or more active ingredients

What can the grower do to advance this research?

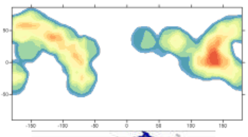
- If you’re a grower or agronomist worried about problematic weeds you can participate in this study
- If resistance is suspected, send weed samples for testing
- Dried seed can be sent in a sealed envelope to Oak Park where we will be conducting resistance screening

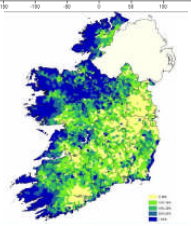
Ronan Byrne, Walsh Fellow

Biotechnology Building,
Teagasc Crops Environment and Land Use Programme
Oak Park Crops Research Centre
Carlow

Future research

- Examine the link between British and Irish populations of black grass through the use of genomics
- Map the density of grass weeds in a systematic way to understand the extent of the issue (requires grower participation)
- Determine the molecular basis for herbicide resistance in the resistant populations we have obtained





Thanks

Many thanks to:

- **Funding:**
  - **Teagasc Walsh Fellowship scheme**
  - **Irish Seed Trade Association**
- **Supervisors:**
  - **Susanne Barth, Teagasc**
  - **Tim O’ Donovan, Seedtech**
  - **Paul Neve, Rothamsted**
  - **Rob Freckleton, The University of Sheffield**
- **Growers and agronomists who participated Summer 2016**

Aphid monitoring and resistance

Louise McNamara
Teagasc, CELUP, Oak Park

Michael Gaffney and Lael Walsh
Teagasc,CELUP, Ashtown

SUMMARY

Aphids are the most serious insect pests of cereal crops in Ireland. Damage occurs through direct feeding and transmission of virus disease to and within crops. In Ireland the grain aphid, *Sitobion avenae*, is the most widely recorded species in the field and the main vector of the prevalent MAV strain of Barley Yellow Dwarf Virus (BYDV). Yield reductions, at Oak Park, due to BYDV have been as high as 3.7 t/ha in winter barley and almost 2 t/ha in late-April sown barley. Control has relied heavily on the application of pyrethroid insecticides. Wheat and oats are also susceptible to BYDV but have additional protection due to being sown later in autumn and earlier in spring than barley.

In England, during 2011 there were reports of aphid control failures where pyrethroids had been sprayed on barley crops. Aphid samples were collected from affected areas and were screened for resistance. This lead to the identification of the knockdown resistance (kdr) mutation in English samples of *S.avenae*. Furthermore laboratory tests confirmed adult aphids carrying this mutation displayed up to 40-fold resistance to lambda cyhalothrin, a pyrethroid used to control this pest.

Recent research in Ireland has confirmed the presence of aphids with the knock down resistance (kdr) mutation in field collected grain aphids, which confers varying resistance to pyrethorid insecticides. An initial assessment in summer 2013, from an aphid sample collected from spring barley in County Cork was confirmed to have the kdr mutation. In 2014 aphid control failures were reported at a site in Tipperary with samples testing positive for the kdr mutation. Grain aphid adults were collected from barley crops in 2015 and 2016. This confirmed aphids carrying the kdr mutation have been recovered from the five major (in terms of acreage) grain growing counties in Ireland. To date, only partially resistant *Sitobion avenae* heterozygotes (kdr-SR) have been recovered, and no fully resistant (kdr-RR) individuals have been identified internationally. In parallel testing, the MAV isolate of BYDV was confirmed to be the most prevalent strain in Ireland. Unsprayed fields and grass margins were found to harbour kdr-SR individuals; this is unsurprising given aphid mobility and may have implications for 'green bridge' carryover and the local persistence of resistant aphids. Monitoring, describing and ultimately predicting the presence and spread of resistance is fundamental to effective, sustainable use of insecticides as part of an Integrated Pest Management approach.

Acknowledgements: This work is conducted as part of the 'EPIC' project, funded under Stimulus (project 14/S/879), in collaboration of Dr. Gordon Purvis at UCD and Drs Steve Foster and Martin Williamson at Rothamsted Research.

Aphid monitoring and resistance

Louise McNamara
Teagasc CELUP
Oak Park Crops Research

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The Irish Agriculture and Food Development Authority

Background to *kdr* resistance and virus transmission

- *Sitobion avenae* (Grain Aphid)
- Reduces grain yield & quality
- Transmits BYDV
- *Kdr* confers partial pyrethroid resistance

Yield loss due to BYDV	
Crop	Yield Reduction
Winter barley (early Sept)	3.7 t/ha
Spring barley (Late April)	1.99 t/ha
Winter wheat	1.2 t/ha

Kennedy, 2014

The Irish Agriculture and Food Development Authority

Incidence of *kdr* in Ireland

A total of 357 individual *Sitobion avenae* have been tested to date for knock-down resistance (kdr)

The Irish Agriculture and Food Development Authority

Incidence of *kdr* in Ireland

- *kdr* widely present in Irish environment
- High frequency of aphids with the *kdr* gene where pyrethroids used continuously
- Unsprayed fields/grass margins in proximity to cereal fields can harbour *kdr* individuals – likely due to aphid mobility/carry over
- Fitness cost associated with resistance: reduced responses to aphid alarm pheromone

Spring cereal aphid control

- Up to 20 fold more BYDV in April than in March sown spring barley
- Control: Early – March sown no spray.
  April sown single spray at g.s. 14
- Seed treatments not permitted
- Spring Wheat & oats: if sown after mid – April spray pyrethroid at g.s. 14

Kennedy, 2014

Acknowledgments

This work is conducted as part of the 'EPIC' project, funded under Stimulus (project 14/S/879), in collaboration of Dr Gordon Purvis at UCD and Drs Steve Foster and Martin Williamson at Rothamsted Research.

Oilseed rape row spacing and seed rate

Roisin Byrne and Dermot Forristal
Teagasc, CELUP, Oak Park

Tom McCabe,
UCD

SUMMARY

Winter oilseed rape is the most widely grown oilseed crop in northern Europe. Oilseed rape is typically sown at 125mm row spacing at seed rates of 50-80 seeds m^{-2}. Recent interest in low soil disturbance strip-tillage for establishing oilseed rape has resulted in some commercial growers seeding at 600mm row widths with relatively little research available to support this practice. The focus of the work reported here is to determine the impact of row spacing and seed rate on oilseed rape development and yield. Other aspects of crop establishment and management including cultivation systems and nitrogen rates and timings are also beng studied.

Experimental field trials to determine the impact of row width (125, 250, 500 or 750mm), seed rate (10, 15, 30 or 60 seeds m^{-2} respectively) and variety biomass type (standard and semi-dwarf) on crop establishment, growth and yield were carried out over two growing seasons, on three sites using conventional plough establishment. Crop establishment and regular assessments of biomass, leaf area, total green area and crop light interception were carried out during the season. The pod and seed numbers at harvest were counted and final yield values determined.

The results showed that seed rate or row spacing did not impact significantly on yield at the individual sites. Pod numbers did not differ significantly when sown either at a wide (750mm) or a narrow (125mm) row spacing, even at lower seed rates. This may be due to the crops ability to alter its canopy structure when growing at different plant densities. A dense crop will concentrate all of the pod numbers nearer the top of the canopy, due to better light availability. A wider row width at a lower seed rate however, allows the crop to branch out and fill pods lower down the plant, which may not have filled to the same extent in a denser canopy. While there was no significant effect of seed rate or row width on the yield at individual sites, there were some non significant effects which warrant a more thorough statistical analysis encompassing all sites, but differences if any will be small.

These findings suggest that wide-row, low-disturbance establishment systems can be used to reduce costs and achieve timely sowing, and that there is scope to use lower seeding rates where weed control and pigeon damage are not challenges.

Oilseed rape row spacing and seed rate

Roisin Byrne and Dermot Forristal
Teagasc CELUP
Oak Park Crops Research

Tom McCabe
UCD

Strip-Till research in OSR

- Strip tillage is a rapid low cost establishment method for OSR

BUT

- Crop established in wide rows (60cm+) must compensate to maintain yield
- **Research Programme**
  1. Cultivation Systems
  2. Nitrogen Rates and management
  3. **Row spacing and seed rates**
     - Spacing: 125, 250, 500 and 750mm
     - Seed rates: 10, 15, 30 and 60 seeds/m²
     - Standard and semi-dwarf varieties

Wide Row-600mm (Strip-Tillage)

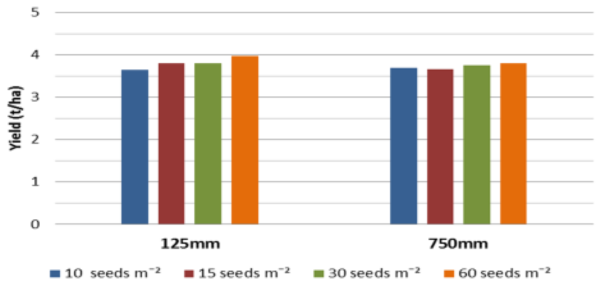
Conventional 125mm (Plough)

Research programme

- **Measured** (3 site/seasons):
  - Plant establishment
  - Biomass development
  - Pod numbers
  - Yield and yield components at harvest

Effect of seed rate on yield

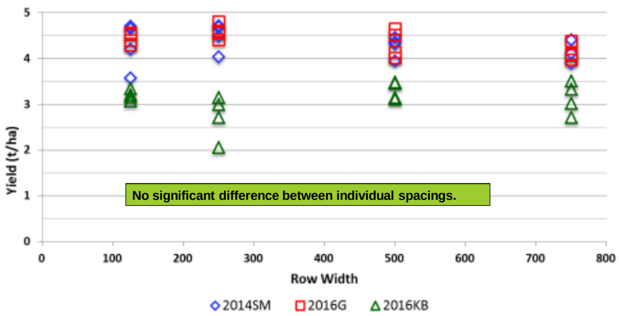
average of three sites/seasons



No significant difference found between individual seed rates

Effect of row spacing on yield

Constant seed rate of 60 seeds/m²



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Conclusions

- Seed rate and row spacing had a relatively small impact on final yield
- Suggests that oilseed rape has the ability to compensate for lower plant numbers and wider spacing
- Scope to reduce costs by using low seed rates where weed control and pigeon damage are not a factor
- Wide row, low disturbance establishment systems can be used to reduce costs and achieve timely sowing

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Understanding genetic resistance to Septoria

Gerard Hehir, Cliona Connolly and Ewen Mullins
Teagasc, CELUP, Oak Park

SUMMARY

Zymoseptoria tritici, the causal agent of septoria tritici blotch (STB), is a serious and persistent threat to Irish wheat production, causing yield losses of up to 50% where susceptible varieties are grown under weather conditions conducive to STB development. As Ireland has no indigenous cereal breeding programmes, we rely on varieties bred specifically for Great Britain and Northern Europe, which may not necessarily have STB resistance as a primary trait. In the absence of commercial varieties with durable resistance, the cereal sector is currently reliant on extensive fungicide programmes to control disease. As a result over 70% of Ireland's fungicide usage in wheat is targeted towards STB, which is not sustainable in light of environmental and legislative challenges. The current over-dependency on fungicides to control STB has driven the evolution of fungicide insensitive/resistant strains of *Z. tritici*, which to date has negated the efficacy of many commercial fungicides. Taken together, the wheat production sector in Ireland is facing an uncertain future unless greater emphasis is placed on developing durable genetic resistance to STB. While it is very unlikely we will re-establish commercial breeding programmes for cereals in Ireland, an alternative approach is to develop tools that identify breeding lines with the potential for durable STB resistance via a combination of intensive field assessments and biotechnology-based approaches.

In this regard, we have examined closely STB disease progression within a collection of pre-commercial and elite wheat lines. Completed across three locations that typically represents high, medium and low levels of STB pressure, this study investigated the genetic potential of the synthetically derived wheat cultivar Stigg to delay STB epidemics. In the context of the 3 years studied here, the phenotype of cv. Stigg maintained a strong level of partial STB resistance. This was characterised by a lengthened latent period, which in effect slowed down the production of fungal pycnidia on the leaf surface after infection, thereby slowing down the disease epidemic. However, once the latent period was concluded it was followed by a rate of disease progression comparable to that observed in more susceptible varieties. The data indicates that any extension in the latent period of the *Z. tritici* disease cycle would represent an important step in developing more resistant wheat varieties due to the overall reduction in airborne septoria spores within the crop canopy. Currently, work is underway to identify the genes involved in this process in cv. Stigg, which once characterised will be used to support the development of novel wheat varieties for the Irish market.

Understanding genetic resistance to Septoria

Gerard Hehir, Cliona Connolly and Ewen Mullins
Teagasc CELUP
Oak Park Crops Research

Septoria tritici blotch (STB)

- STB - most economically important disease of wheat in Ireland
- No durable resistant cultivars available
- Requires 3-4 sprays through growing season
  - Strains resistant to QoI, DMI and SDHI
- Sustainability of winter wheat in Ireland questionable in long term

Strategy- Identify breeding lines and genes conferring durable STB resistance via a combination of intensive field assessments and biotechnology-based approaches

The Irish Agriculture and Food Development Authority

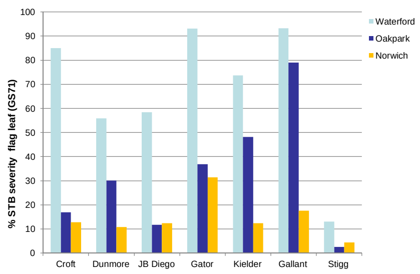
STB field assessments

- 3 years (2014-2016), across 3 three locations
  - **Waterford (high), Carlow (medium), Norwich (Low)**
- STB severity assessed twice weekly on second leaf and flag leaf: GS 35 – senescence
- 7 cultivars selected based STB resistance ratings

Variety	Breeder	STB Rating
Stigg	Limagrain	8
Dunmore	Limagrain	6
JB Diego	Senova	5
Kielder	KWS	5
Gator	KWS	5
Gallant	Syngenta	3
Croft	KWS	4

The Irish Agriculture and Food Development Authority

STB severity - 2015

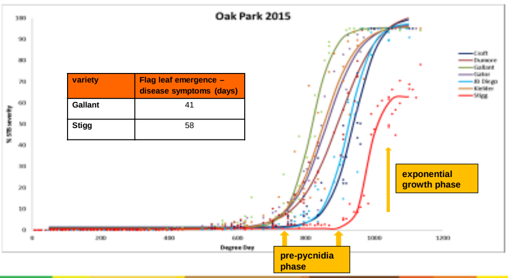


Untreated Yield (t/ha)

Variety	Waterford	Oakpark
Dunmore	8.5	8.2
JB Diego	8.8	7
Croft	9	8.5
Gator	6.5	7.5
Kielder	6.5	7.5
Gallant	**6.2**	**6.5**
Stigg	**10**	**8**

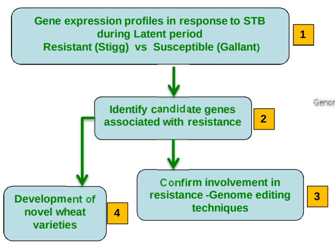
Profile of STB disease progression- Oak Park 2015

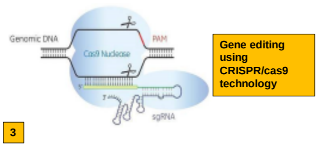
- Epidemiological differences between partial resistance and susceptibility?



Biotechnology- based approaches to identifying durable resistance genes

- What is driving resistance?
  - Stigg: strong levels of partial STB resistance characterised by a lengthened latent period





Genome editing – what is it?

Ewen Mullins
Teagasc, CELUP, Oak Park

SUMMARY

Over time the genetic code of plants, and all organisms for that matter, changes (i.e. mutates) in response to stress and environmental pressures. These changes in the code are called mutations and these have been occurring since the beginning of life and are an important facet of evolution; allowing species to evolve against predators or changing climates etc… Typically, the process is very slow, taking many generations before a novel type of plant/animal appears. However, in the 1940s scientists discovered that by exposing seeds to strong mutagens (e.g. x-rays, nuclear irradiation or harsh chemicals) they could in fact accelerate the rate of mutation and hence generate new material at a quicker pace. By exposing seeds to these mutagens, thousands of mutations are made across the genetic code, affecting the function of thousands of genes, which in turn alters many aspects of a plants physical form (e.g. ability to resist specific diseases, drought stress, leaf shape, seed number). The application of mutation techniques in this way has generated a vast amount of genetic variability and has played a significant role in plant breeding and genetics. To date this process has been successful in generating >3200 novel varieties across 210 plant species, including barley, wheat, oats; examples include the Ruby Red™ grapefruit, the malting barley variety Golden Promise, herbicide tolerant Clearfield™ oilseed rape. While mutation breeding is clearly effective, the mutation process is random and hence the breeder has no control over what genes are being affected. As a result, very large populations (>10,000s) of treated plants must first be assessed before individual plant lines can be identified, which will be of benefit to farmers.

Recently, a more accurate technique of mutation breeding has been discovered that instead of using standard mutagens, relies on the use of proteins to snip or mutate the genetic code of individual genes. In effect, these proteins act as ‘molecular scissors’ and are guided to their target gene using special components that effectively act as a ‘satnav’ for the protein. Using this process, no other genes are affected so the generated variety has only a single mutation as opposed to the thousands of mutations that occur using the traditional mutagenesis methods. Because we now know what many genes in wheat, barley and potato do we now can use gene editing to enhance the activity of individual genes. This in turn has the potential to deliver novel varieties with the ability to combat fungal diseases and other agronomic pressures. As this exciting technology gathers pace, Teagasc is investigating its potential in wheat, barley and potato with a view to generating edited lines with enhanced agronomic outputs. At present, there are no EU or national regulations prohibiting the application of genome editing as a novel crop breeding tool.

Genome editing – what is it?

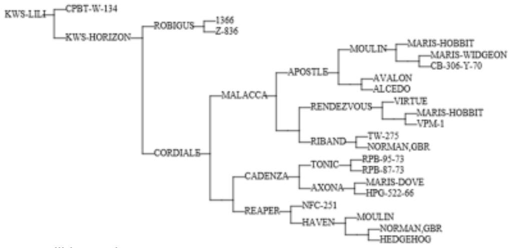
Ewen Mullins
Teagasc CELUP
Oak Park Crops Research

Generating novel varieties - traditional breeding

Variety A	x.	Variety B
Short stem + low STB res		Long stem + high STB res




Generating novel varieties - traditional breeding



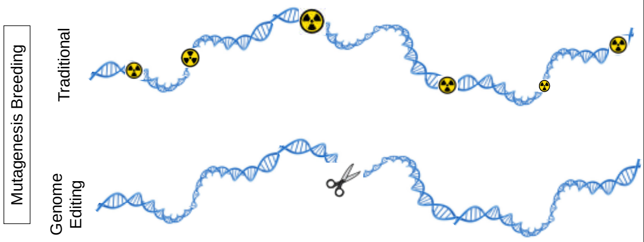
- e.g. cv. Lili is product over ~20 crosses
- But availability of parental material with high value traits is limited
- In 1940s discovered chemical and physical mutagens can modify the genetic code of existing material to produce plants possessing novel traits

Generating novel varieties - mutation breeding

- Using X-rays, nuclear radiation, chemical mutagens
- >3200 varieties generated across >200 plant species
- Clearfield™ oilseed rape, Ruby Red™, Golden Promise malting barley, Japanese pear, legumes, rice…
- No EU regulation
- BUT….
- No control over what genes are mutated
- Very large populations (>10,000s) of mutant lines have to be screened to identify 'upgraded' plant
- Now, proteins can be used to mutate/edit **specific** genes

Generating novel varieties - genome editing

- These proteins (termed CRISPR/Cas) are directed via a 'satnav' component
- Act as a 'molecular scissors' to snip the genetic code.



Generating novel varieties - genome editing

- Genome editing is faster and more precise and can be used to 'upgrade' well-adapted varieties
- For example; powdery mildew resistance in bread wheat

- Teagasc currently investigating potential of genome editing on barley, wheat, potato
- No regulatory restrictions on use of editing proteins for mutation breeding

Factors affecting eyespot in winter wheat

Henry Creissen
Teagasc, CELUP, Oak Park

SUMMARY

Eyespot, caused by the fungal pathogens Oculimacula yallundae (W-type) and O. acuformis (R-type), form part of the complex of diseases that affect the stem base of cereal crops. Eyespot can directly reduce yield of winter wheat by restricting flow of nutrients and water, and can lead to white heads, lodging and yield loss.

Direct relationships between disease severity and yield loss can be difficult to establish often due to site specific reasons, however the application of fungicides (prothioconazole + SDHI) at stem extension (GS31-32) have been shown to consistently reduce disease incidence in the U.K.. A decision support system has been devised in the U.K. to help growers decide whether to apply fungicides targeted towards eyespot at T1. It combines information on cultivation type, previous crop, sowing date, soil type and rainfall with a disease assessment at GS31-32 to estimate risk from eyespot disease. Under the EPIC project (Establishing a Platform for Integrated Pest Management in Irish Crops) this risk based forecast system is being assessed for its relevance to Ireland.

In the 2014-15 and 2015-16 growing seasons a total of 136 crops were sampled at GS31-32 and a further 66 crops resampled at GS70-85 to assess the effect of each of a range of factors (outlined in the paragraph above) on final eyespot severity. Rotation was the only significant factor affecting eyespot incidence @GS31-32 and eyespot severity @GS70-85 with continuous winter wheat crops having on average twice as much disease at both time points compared to crops involved in some form of rotation. All other factors had neglible affects on eyespot. Commercial crops will be sampled again during the 2016-17 and 2017-2018 growing seasons to confirm or reject these conclusions.

The effect of crop variety was clearly observable at field trials conducted at Oak Park in 2015 and 2016, where cv. Revelation, which contains eyespot resistance gene Pch1, provided a 35-65% reduction in final eyespot severity compared to cv. JB Diego and Alchemy.

To prevent eyespot becoming an issue on your farm it is vital that the disease is correctly identified and monitored during and between seasons. The introduction of a non-cereal break crop into the rotation and the use of resistant varieties will help to reduce threat from eyespot. Fungicides at T1 provide some level of control but only if applied according to best practice guidelines.

EPIC IPM

Department of Agriculture, Food and the Marine
An Roinn Talmhaíochta, Bia agus Mara

Factors affecting eyespot in winter wheat

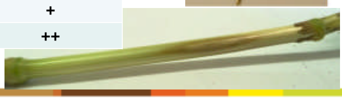
Henry Creissen
Teagasc CELUP
Oak Park Crops Research

EPIC IPM

Eyespot risk forecasting

- Stem base disease
- Oculimacula yallundae (W type)
- O. acuformis (R type)

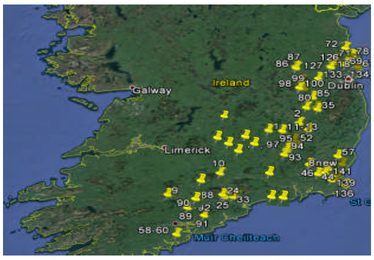
Factor	Effect on eyespot
Ploughing	+/-
Preceding host crops	++
Early sowing date	++
Heavy soil	+
High rainfall (region)	++



EPIC IPM

Sampling

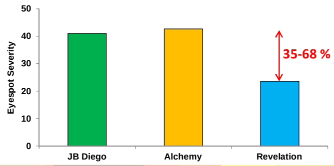
- 2015 (31 crops) + 2016 (105 crops)
- Sampled @GS31-32 + GS70-85



Important factors in Ireland

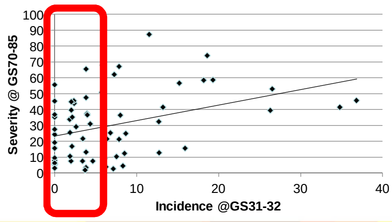
- Rotation! (P>0.001)

- Variety *(trials data)*
  - Pch1 gene
    - Revelation
    - Skyfall
    - RGT Illustrious
    - KWS Zyatt



Disease progression

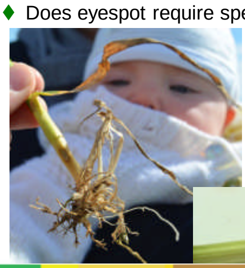
- **Incidence (April) ≠ Severity (July)**
- Fungicides: Azole + SDHI @T1
- Species?: R type = less symptomatic @GS31-32

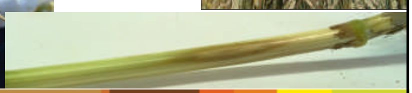


The Irish Agriculture and Food Development Authority

Monitoring

- GS 31-32 (just prior to T1) + GS70-85
- Keep records
- Does eyespot require specific attention?





The Irish Agriculture and Food Development Authority

Notes: