NATIONAL TILLAGE CONFERENCE 2016

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Crops Environment and Land Use Programme

Oak Park Crops Research

Carlow

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Tel: 059-9170200

Fax: 059-9142423

www.teagasc.ie

Programme

09.30	Registration/Tea/Coffee
10.30	Conference Opening ***Paddy Browne, Head of Programme, CELUP***
Session 1:	***Chaired by John Spink, Head of Crop Science Department***
10.45	Grass weed control – learning from the mistakes of the English ***Sarah Cook, ADAS***
11.45	Winter wheat growth and development ***Joseph Lynch, Teagasc***
12.15	Wheat disease control and resistance issues ***Steven Kildea, Teagasc***
12.45	Discussion and Q&A
13.00	Lunch
Session 2:	***Chaired by Andy Doyle, Irish Farmers Journal***
14.30	Benefits of participation in tillage discussion groups ***Phelim McDonald, Teagasc and Gilbert Smyth, Farmer, Carlow***
15.00	Cropquest: A study of rotations and break crops ***Dermot Forristal, Teagasc***
15.30	Bean production and agronomy ***John Carroll, Teagasc and Ivor Deverell, Farmer, Offaly***
16.00	Close of Conference ***Professor Gerry Boyle, Teagasc Director***
16.15	Tea/Coffee

Contents

Grass weed control - learning from the mistakes of the English

Dr Sarah Cook,
ADAS UK Ltd
ADAS Boxworth, Boxworth, Cambs CB23 4NN

SUMMARY

Black-grass or slender foxtail (*Alopecurus myosuroides*) is an annual grass with upright slender stems and fine hairless leaves. It germinates between August and October (80%) with a small spring flush in March and April, particularly if land is cultivated at that time. In May to August approximately 10 heads per plant are produced, each head containing 80-150 seeds. Seed is shed prior to harvest.

Moderate to severe infestations of black-grass are found predominantly in the East midlands, East and South East of England. In recent years the weed has spread north and west in straw and on contractors machinery such as balers and pea viners. In an ADAS survey (September 2015) 60% of growers said that black-grass had increased in severity in the past 5 years with 21% of growers spending over €120/ha for its control. In winter wheat yield losses of 13% can occur where 100 heads/m² are present.

Herbicides no longer provide reliable control of black-grass due to multiple herbicide resistance occurring on 98% of farms with black-grass present in England. The weed has resistance to group A (‘fop’, ‘dim’ and ‘den’) and group B (Sulphonylureas) herbicides through two mechanisms - target site and enhanced metabolism. The weed has increased on farms that have a rotation containing less than three crops which are mainly autumn sown, use the same tillage system each year, drill before mid-September and predominantly use post emergence applications of group A and B herbicides for grass weed control.

Understanding the agroecology of the weed can improve control of black-grass through identifying weaknesses in its lifecycle. Delaying drilling can avoid the peak emergence period, ploughing can bury the weed below germination depth, using higher crop seed rates can make the crop more competitive, changing to a spring crop allows an extended opportunity to control the weed with a non-selective such as glyphosate.

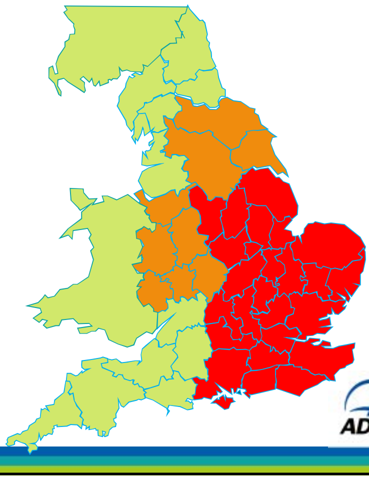
Similar approaches in cultural control can be taken to reduce populations of canary grass and barren brome, but in addition cultivation soon after harvest to encourage germination will reduce populations.

Content

- Location
- Biology
- How quickly it can become a problem
- Prevention
- Cure?
- Comparison with existing problems

Black-grass is mainly found in the east of the UK

ADAS survey - May, 2015

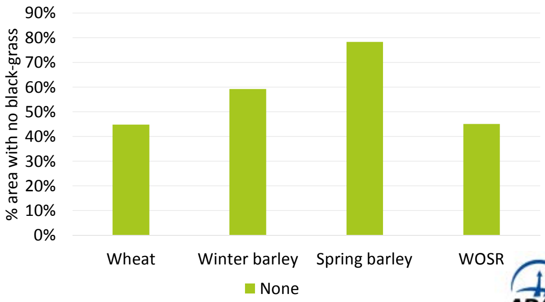


How bad is it?

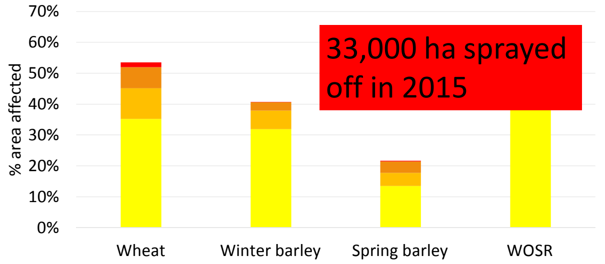
- 60% of growers said BG had increased in severity over past 5 years
- 21% spending over €120/ha on herbicides for control of black-grass

ADAS and Syngenta surveys 2015

Less black-grass in winter and spring barley



Most severe in wheat, least in barley, present in WOSR



	Level	Population	Effect on yield
	Slight	Some	none
	Moderate	patches	0-5%
	Severe	Widespread	>5%
	Complete	Sprayed off	100%

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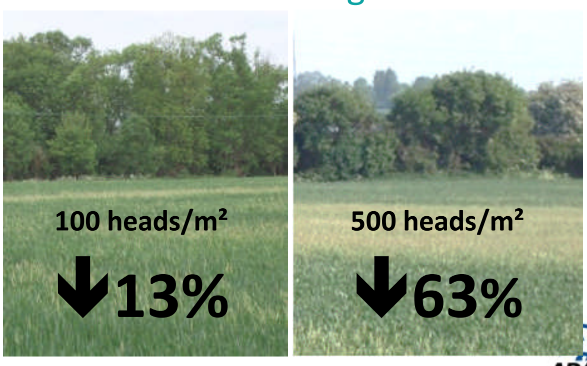
Yield losses can be high



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So how can black-grass get here?

- Be careful using:
  - Imported straw
  - Borrowed/hired machinery
- Make sure seed is clean
- Don’t let it set seed
  - Rogue low populations
  - Burn out large patches

ADAS

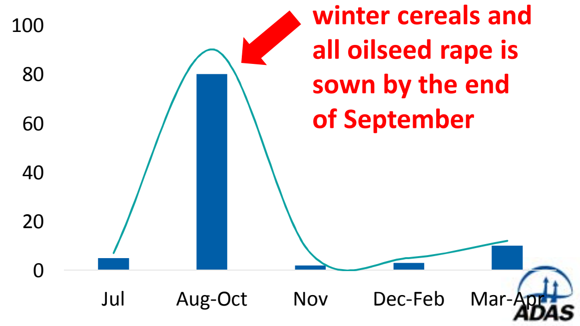
Biology

Understand how the weed grows and reproduces.

Identify the weak points in its lifecycle.

80% emerges in early autumn (Aug-Oct)

More than 50% of winter cereals and all oilseed rape is sown by the end of September



Black-grass seed production

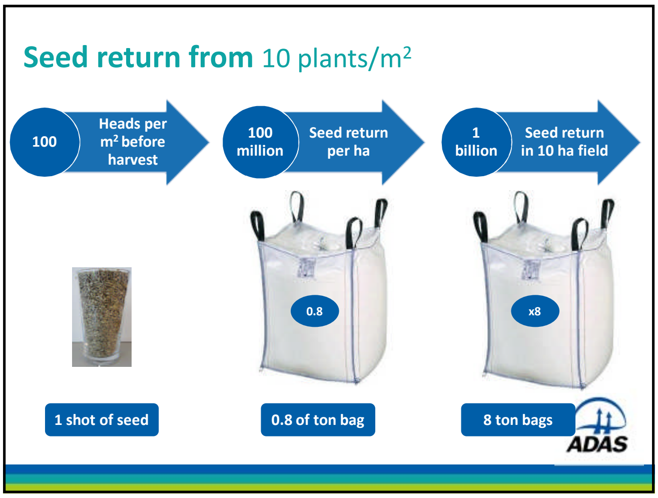
1 plant	**10 ears**
Seeds/ear	**80-150**
Seeds/ Plant	**200-2000**

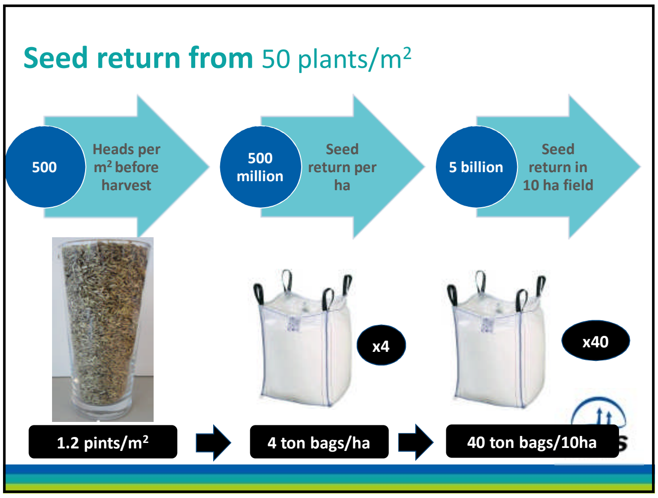
How fast can it increase?

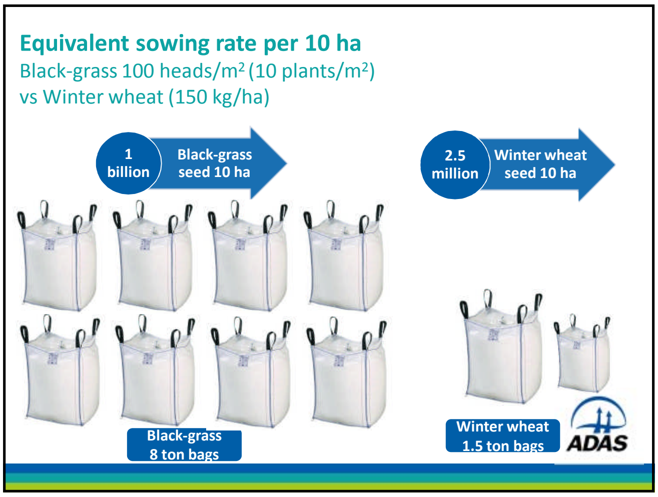
1 plant

10 heads

1000 seeds

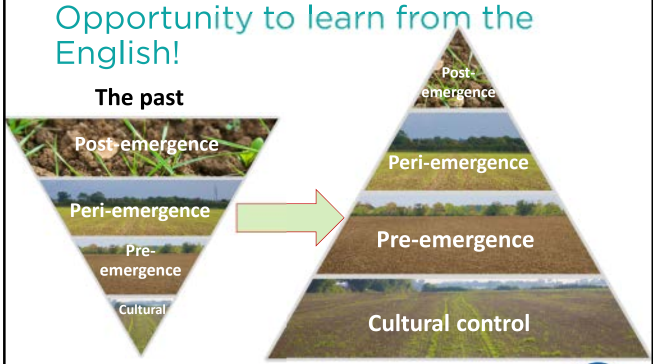

Seed return from 10 plants/m2
100
Heads per m2 before harvest
100 million
Seed return per ha
1 billion
Seed return in 10 ha field
0.8
x8
1 shot of seed
0.8 of ton bag
8 ton bags
ADAS


Seed return from 50 plants/m2
500
Heads per m2 before harvest
500 million
Seed return per ha
5 billion
Seed return in 10 ha field
x4
x40
1.2 pints/m2
4 ton bags/ha
40 ton bags/10ha


Equivalent sowing rate per 10 ha
Black-grass 100 heads/m2 (10 plants/m2)
vs Winter wheat (150 kg/ha)
1 billion
Black-grass seed 10 ha
2.5 million
Winter wheat seed 10 ha
Black-grass 8 ton bags
Winter wheat 1.5 ton bags
ADAS

Opportunity to learn from the English!

The past



Now this approach is crucial

ADAS

What are the worst things you can do?

- Continuous autumn cropping - cereals
- Same cultivation type every year
  - non-inversion is worse
- Early drilling (August/September)
- Poor crops
- Post emergence herbicides only
- Allowing seed return

ADAS

Other grass weeds

Awned canary grass

Canary grass

Barren brome

Germinate Aug/Sept/Oct
Shed seed before/at harvest
Top 5cm of soil
Seed persists up to 5 years

ADAS

Other grass weeds

Awned c

Cultural control works for all grass weeds

Barren brome

Shed seed before/at harvest
Top 5cm of soil
Seed persists up to 5 years

Cultural control

Proven effects of non-chemical control of black-grass in winter wheat

Method	Potential to decrease numbers	% reduction achieved	
		Mean	Range
Ploughing	+++	69	- 82 to 96
Delayed drilling	++	31	- 71 to 97
Higher seed rates	+	26	+7 to 63
Competitive cultivars	+	22	+8 to 45
Spring Cropping	+++	88	+78 to 96
Fallowing	+++	70-80	-

Based on: A review of the effects of crop agronomy on the management of *Alopecurus myosuroides* by P J W Lutman, S R Moss, S Cook & S J Welham. (2013). Weed Research 53, 299-313

Non-chemical control of brome, wild oats and AMG in winter wheat

Method	% change achieved		
	Wild oats	Brome	AMG
Ploughing	↓80	↓95	↓60
Direct drilling	↓40	↑50	↑100
Delayed drilling	Beneficial	Beneficial	No benefit
Higher seed rates	No data	↓<40?	↓40
Competitive cultivars	No data		
Spring Cropping	Beneficial? winter w. oat	Beneficial	No effect

Based on: a review by Moss and Lutman

Managing the seedbank
- the heart of all good weed control

- Soil contains many weed seeds
  - the 'seedbank'
- Weeds generally emerge only from the top 5cm of soil
- Cultivations stir the seedbank, bury fresh seed and bring old seed up
- Some buried seed becomes dormant, some dies

Seed longevity

Longevity	Grasses
Under 1 year	Soft brome, rye brome, **barren brome**, volunteer cereals, oats
1-5 years	Perennial rye-grass, **black-grass** and winter wild-oat, **canary grass?**
Over 5 years	Wild-oat, Italian rye-grass and many others

Managing the weed seedbank

- Encourage weed seeds to germinate by changing crop type, cultivation timing and drilling dates
- Prevent weeds from setting and shedding seed

Cultivations
- changes weed population as much as crop establishment

Stubble cultivation

- Shallow cultivation (5 cm/2”) immediately after harvest can stimulate germination eg barren brome and volunteer cereals
- Reduces AMG
- But soil needs to be moist
- Can make oilseed rape dormant in dry conditions
- Keeps trash near surface, but prevents wildlife eating seeds

Optimum stubble management strategy for freshly shed weed seeds

Weed species	Cultivate soon after harvest	Do NOT cultivate soon after harvest
Volunteer cereals	✓	
Sterile Brome	✓	
Soft brome	✓	
Black-grass		✓
Wild-oats		✓
Rye-grass		✓
Meadow brome		✓

Optimum stubble management strategy for freshly shed weed seeds

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Volunteer cereals	✓	
Sterile Brome		
Soft brome		
Black-grass		
Wild-oats		
Rye-grass		
Meadow brome		

Little benefit (20% reduction) – better in low dormancy years, moves seed into moisture

Optimum stubble management strategy for freshly shed weed seeds

Weed species	Cultivate soon after harvest	Do NOT cultivate soon after harvest
Volunteer cereals	✓	
Sterile Brome		
Soft brome		
Black-grass		
Wild-oats		
Rye-grass		
Meadow brome		

Little benefit (20% reduction)

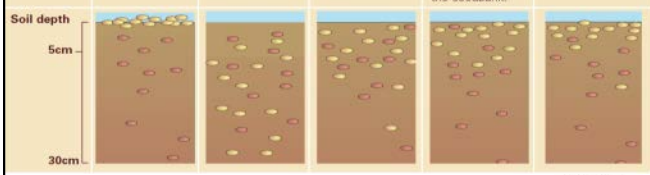
Increases emergence but reduces predation

Primary cultivations

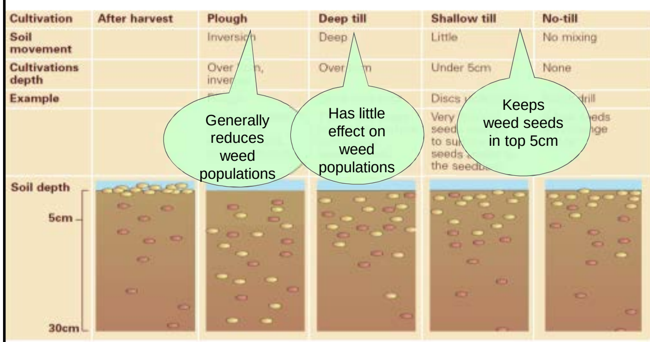
- First cultivation to prepare soil for next crop
- Balance between bringing older seed from depth and burying newly shed seed

Cultivation options and effect on weed seedbank

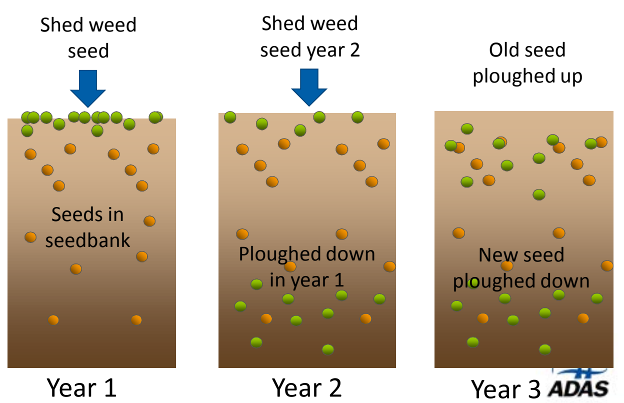
Cultivation	After harvest	Plough	Deep till	Shallow till	No-till
Soil movement		Inversion	Deep	Little	No mixing
Cultivations depth		Over 5cm, inverted	Over 5cm	Under 5cm	None
Example		Plough	Discs over 5cm	Discs under 5cm	No-till drill
		Many old seeds brought to surface, most new seeds buried.	Fewer old seeds brought to surface, some new seeds buried.	Very few old seeds brought to surface. Few seeds added to the seedbank.	A few seeds may change layers.



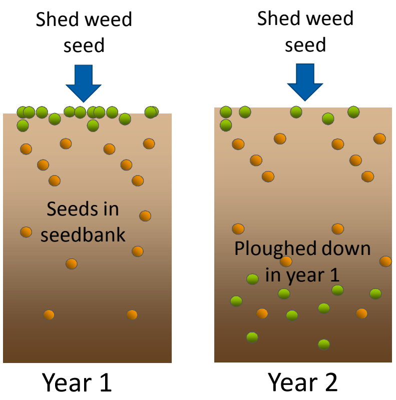
Cultivation options and effect on weed seedbank



Rotational ploughing



Rotational ploughing



- Don't plough in year 2
- Plough year 3-6
- 75% seed dies per year

Ploughing- summary

Success affected by:

- Infestation level- how much trash to bury
- Past cultivation history – don't plough it up
- Weed seedbank
- Soil structure and moisture
- Complete inversion - skill

Disadvantages

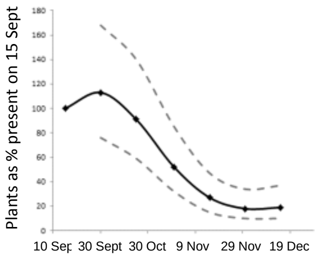
- Slow
- Can add €30-50/ha to costs

Drilling date

- has a major effect on weed species and number

- The gap between crops allows use of a non-selective herbicide
- Delaying drilling increases the time available for weed control
- But can reduce crop competitiveness but seedrate can be increased to compensate
- All weed seedlings should be killed before drilling

Delayed drilling reduces black-grass populations



- Decline from 30 September
- 50% reduction by end of October

From Lutman, Moss, Cook and Welham, 2013

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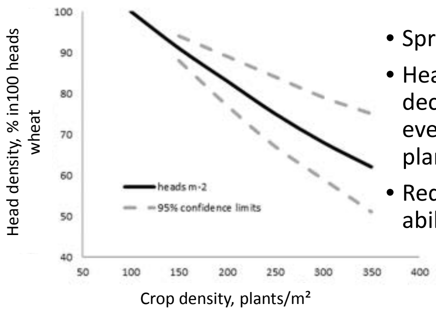
Increasing crop density can be effective



- Spring effect
- Head density declines 15% with every 100 wheat plants/m^2
- Reduces tillering ability of black-grass

From Lutman, Moss, Cook and Welham, 2013

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Crop choice
- the essential building block of any rotation

Changing the crop affects:

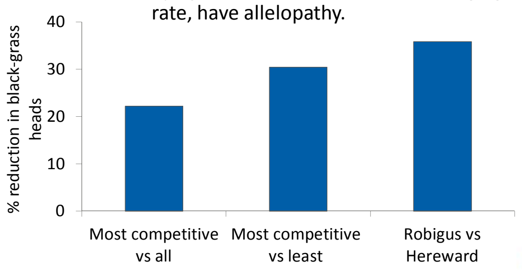
- Time of drilling
- Type and timing of cultivations
- Herbicide choice
- Use of competitive species

The ideal rotation should involve a balance of different crops and be economically viable.

ADAS

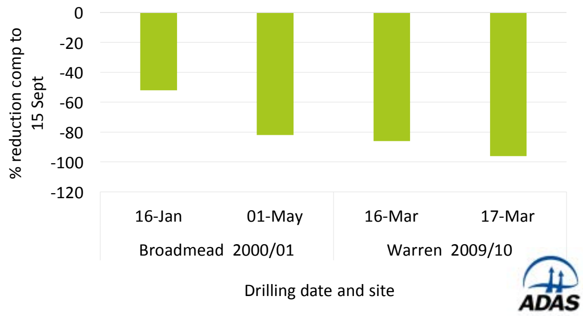
Up to 36% control from a competitive variety

- Competitive varieties tend to be tall, have upright leaves, tiller more, have a high growth rate, have allelopathy.

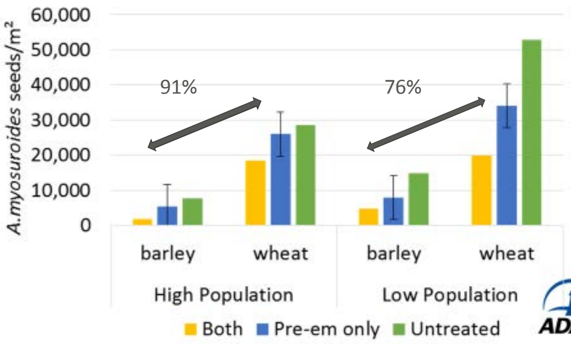


From Lutman, Moss, Cook and Welham,2013

Spring cropping of cereals can result in a 90% decrease in black-grass population



Black-grass – seed return in hybrid barley



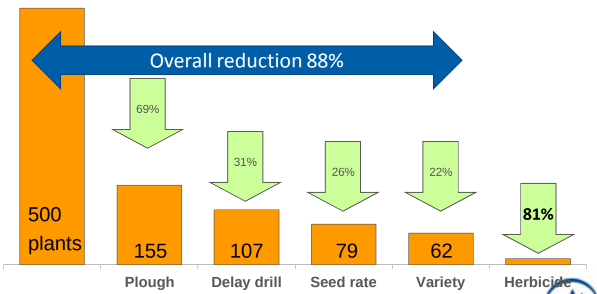
Maximising crop competition

- A product of seed rate and drilling date
- Low rates leave space for weeds to establish
- Early drilling increases tillering
- Establishment declines with late drilling = less competitive crops
- Increase seed rates to compensate
- Change the species – barley, oats
- Some varieties are more competitive?

Effects of cultural control is cumulative

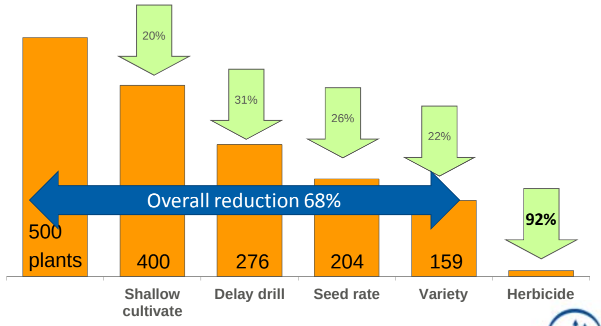
- A combination of cultural control is more effective
- A well timed non-selective herbicide (glyphosate) is very valuable (approx 75% control).

Potential cumulative benefit of cultural control in black-grass – plough based system – in wheat



Typical season based on real data

Potential cumulative benefit of cultural control in black-grass – shallow cultivation system – in wheat



Typical season based on real data

ADAS

Herbicide resistance

Herbicides use is not sustainable in the long-term

ADAS

Herbicide resistance is already present in Europe

Group	A	B	C
Canary grass	✓	✓	✓
Awned canary grass	✓	✓	✓
Black-grass	✓	✓	✓
Barren brome	✓	✓	

ADAS

Which herbicide are in these groups ?

Group	Active substance	2001
A	Clodinafop	Topik
	Pinoxaden	Axial
	Cycloxydim	Laser
B	Iodosulfuron + mesosulfuron	Atlantis
	Flupyrsulfuron methyl	Lexus
C	Isoproturon	Arelon

Herbicide resistance

- 97% black-grass is resistant to commonly used herbicides
- **No field resistance to pre-emergence herbicides**

Resistant black-grass found here

Enhanced metabolism resistance (EMR)

or non-target site resistance

- Commonest mechanism in the UK
- Herbicide is 'detoxified' by plant
- Can effect all herbicides
- Generally not complete resistance
- Increases slowly

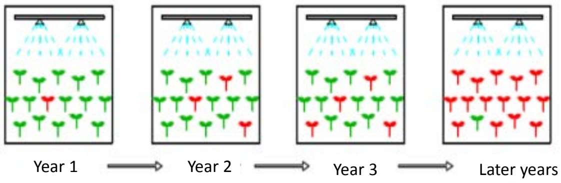
ACCase TSR

- Site of action blocked for group A – 'fop', 'dim' + 'den' herbicides
- Grass-weeds only
- Very specific
- Very poor control
- Increases rapidly

ALS Resistance

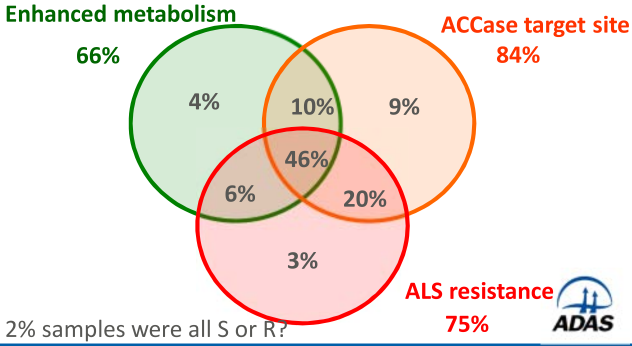
- Site of action blocked for sulfonylurea (SU) + related herbicides
- Grass + broad-leaved weeds
- Very poor control
- Increases rapidly
- Could be EMR also

Resistance build up depends on survivors



From Eshagh Keshtar thesis, 1015

46% of samples RR or RRR resistant to all mechanisms (125 samples, BASF 2013)



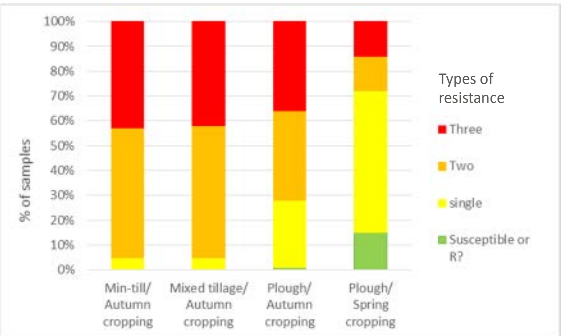
2% samples were all S or R?

Resistance levels never decline

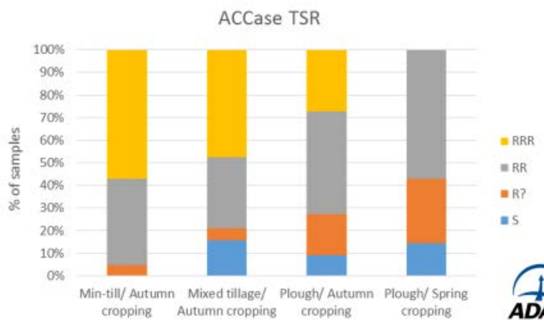
Eradicate the weed

How do the English increase populations of resistant black-grass?

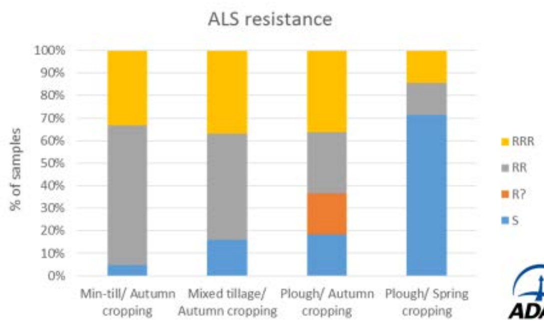
More resistance with continuous min-till and autumn cropping



High levels of ACCase TSR resistance with min-till and autumn cropping



Levels of resistance increase with monoculture and min-till



Summary

Its not just about herbicides

- Primary aim is to reduce populations of weeds
- Cultural control is key part of any weed control programme.

Cultural control

- Can give variable results
- Influenced by weather conditions
- Have associated added costs
- Can reduce the pressure on herbicides

Cultural risk factors

Risk factor	Low	High
Crop rotation	> 3 crops	Mono-culture
Spring sown crops	>25% rotation	None
Cultivation system	Include plough	Monoculture
Autumn drilling date	After mid Oct	Before Mid Sept
Higher seed rates Competitive cultivars Fallow	Many	None
Weed levels	Low	High

Herbicides should be the last resort – no survivors!

- Herbicides are great – we must work to keep them effective
- Need to achieve 97% control to prevent populations increasing

Herbicide risk factors

Risk factor	Low	High
Grass weed herbicides used	<1 per year	3 or more per year
Fops and dims (Group A)	<1 per 3 years	Used every year
Grass SU's (Group B)	<1 per 3 years	Used every year
Other grass modes of action	>50% of herbicide programme	<50% of herbicide programme

Always use a pre-emergence herbicide

Any questions?

Winter wheat growth and development

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

SUMMARY

Depite Irish winter wheat yields being amongst the highest globally, high crop input costs coupled with low grain prices has highlighted the need for further increases in yield to enable the sustainability of wheat production in Ireland. An improved understanding of how this crop grows in the Irish climate is needed to identify the potential factors inhibiting further yield increases, and to help growers facilitate the conditions required to maximise yield formation.

Monitor crops of winter wheat were grown at sites in Carlow, Cork and Belfast during the 2012-13, 2013-14 and 2014-15 seasons. Crops were managed as standard practice with inputs applied at levels non-limiting to crop growth. Assessments of crop growth and development were conducted on a weekly basis during the growing season.

The weather during all three seasons was considered adequate to facilitate an average-to-high yield winter wheat crop, with national average grain yields of 9.3, 10.2 and 11.0 t/ha for each of the years, above the 1995-2015 average of 9.2 t/ha.

Differences between the hand harvested grain yields of the monitor crops (range of 10.7 – 15.8 t/ha) was primarily influenced by differences in either ear number (472 – 666 ears/m^2) or grain size (41.7 – 58.2 g/thousand grain weight). The highest yielding monitor crops achieved both a high ear count and a large grain size, highlighting the importance of both shoot number and grain filling to achieve high yields.

Crops that achieved the highest ear numbers (Belfast 2013, Cork 2014, 2015; 600-666 ears/m^2) were characterised by a plant establishment of over 200 plants/m^2, a moderate degree of tillering prior to stem extension (3.1 - 3.9 tillers/plant), and a high rate of tiller survival during the stem extension phase of growth. Thus, encouraging tiller survival during stem extension through reduced crop stresses and adequate nutrition is an important contributor to high yielding crops.

Large grain sizes were observed (Carlow 2014, 2015, Cork 2014; 53.6-58.2 g/thousand grain weight) in crops that intercepted a high amount of solar radiation post-flowering, enabled by the establishment of a relatively strong green canopy (6.3 - 6.7 GAI) for a sustained duration during June and July, months that provided high levels of radiation. Therefore, avoidance of early scenescense through the prevention of disease infection also contributes significantly to high-yielding Irish crops.

Therefore, results from the 2013 - 2015 monitor crops indicate that high-yielding Irish crops of winter wheat are most sensitive to growing conditons during both the later-vegetative growth stages and the grain filling period.

Winter wheat growth and development

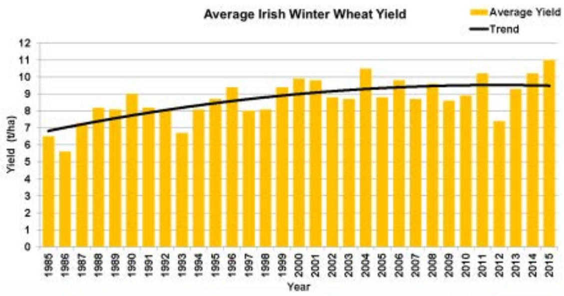
Joseph Lynch, John Spink and Deirdre Doyle

Teagasc CELUP

Oak Park Crops Research

Background

- Average wheat yield plateauing



The Irish Agriculture and Food Development Authority

CIVYL project

- Better understand the factors influencing Irish grain yields
- Determine cereal yield potential across country


The Irish Agriculture and Food Development Authority

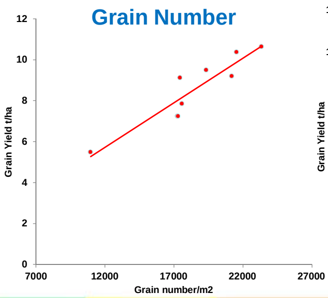
Grain yield

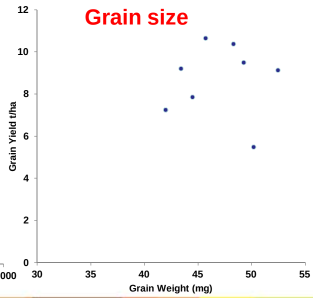
Grain number | **Grain size**

Does one component influence yield more?

Spring barley example

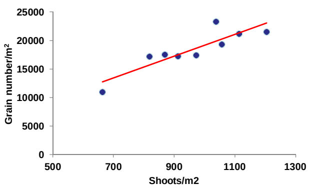
- Grain number is a primary factor for spring barley yield





Spring barley example

- Grain number primarily influenced by shoot number



Winter wheat yield determinants?

- Similar work conducted for winter wheat from 2012-2015
- Identify:
  - Components that influence winter wheat yield
  - Crop factors that drive changes in these components
  - Benchmark growth and development for a high-yielding Irish wheat crop

Winter wheat monitoring

- 3 Sites (Carlow, Cork and Belfast)
- 3 Seasons (2013,2014,2015)
- Variety: JB Diego
- Sowing dates and agronomic inputs as standard practice



Reference crops high yielding (mostly)

Year	Site	Combine Yield (t/ha)	Local Average[1](t/ha)	% Difference
2013	**Carlow**	8.0	9.4	-15
	Cork	11.1	10.0	+11
	Belfast	12.1	7.3	+66
2014	**Carlow**	11.2	10.2	+10
	Cork	12.4[2]	10.1	+22
	Belfast	9.9	7.5	+31
2015	**Carlow**	11.2	10.2	+10
	Cork	11.8	10.4	+13
	Belfast	10.4	-	-

[1] Based on Teagasc County Averages and DARD Northern Ireland report
[2]Estimated from pre-harvest sample

Wheat yield components

Grain number

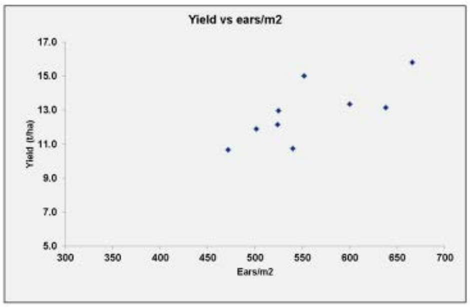
Ear number

Grains per ear

Grain size

The Irish Agriculture and Food Development Authority

Wheat yield components



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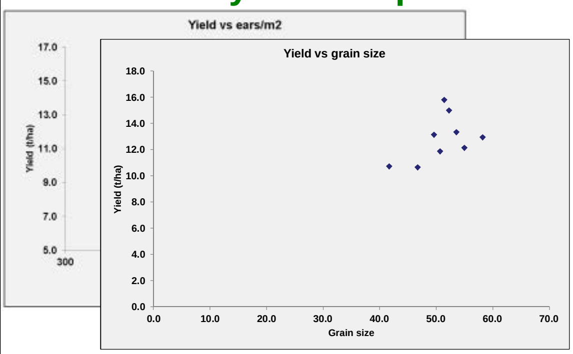
Wheat yield components



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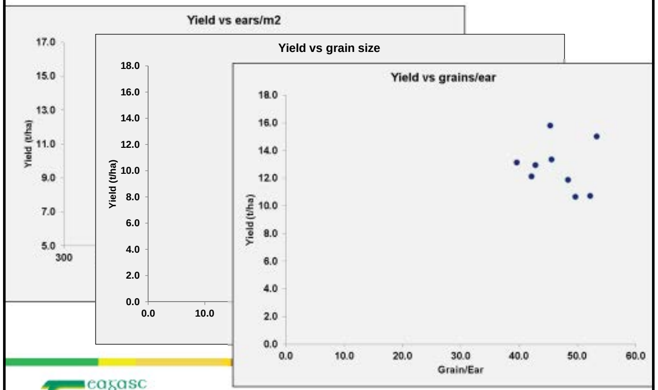
Wheat yield components



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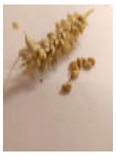
Wheat yield components

	Ear Number	Grains Per Ear	Grain Weight
			
Significant influence?	✓	✓	✓
P-value	0.001	0.013	0.004

The Irish Agriculture and Food Development Authority

Yield components

Low
Moderate
High

Site	Yield (t/ha)	Ears/m²	Grain size (mg)	Grains/Ear
Carlow 2013	10.7	472	46.7	50
Carlow 2015	12.9	525	58.2	43
Cork 2015	13.1	638	49.6	40
Belfast 2013	15.8	666	51.4	45

The Irish Agriculture and Food Development Authority

Winter wheat yield components

- Ear number and grain size greatest influence on grain yield
- Grains per ear can compensate somewhat for low ear numbers
- Crops were grown in relatively high-yielding seasons
- Crops well protected
- Low lodging conditions

Ear Numbers

The Irish Agriculture and Food Development Authority

Achieving high ear numbers

- Avoid low plant numbers (<200/m^2)
- ~800 shoots at stem extension

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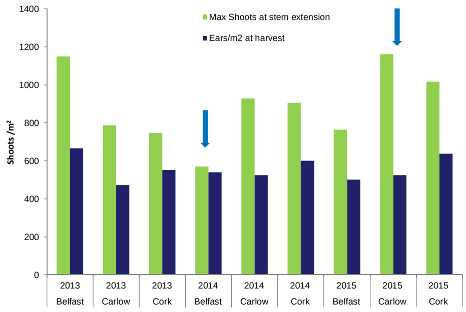
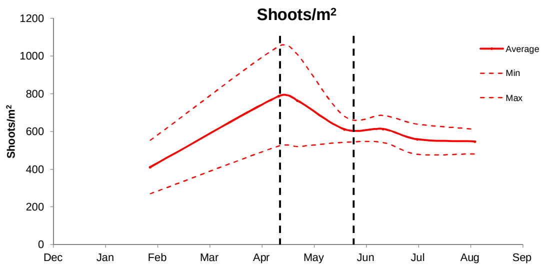
Lots of tillering ≠ lots of ears?



Shoot survival is key



Teagasc The Irish Agriculture and Food Development Authority

Achieving high ear numbers

- Avoid low plant numbers (<200)
- ~800 shoots @ stem extension
- 550-650 ears/m^2

Teagasc The Irish Agriculture and Food Development Authority

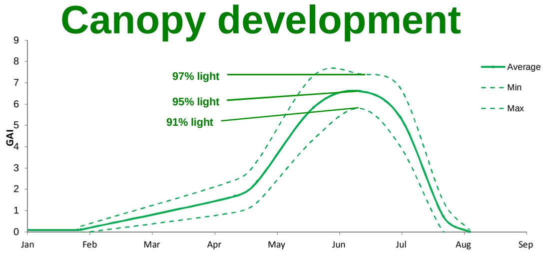
Grain Weight

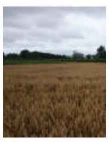
Grain filling

- Canopy size and survival
- Radiation
- Temperature

Teagasc
The Irish Agriculture and Food Development Authority

Canopy development





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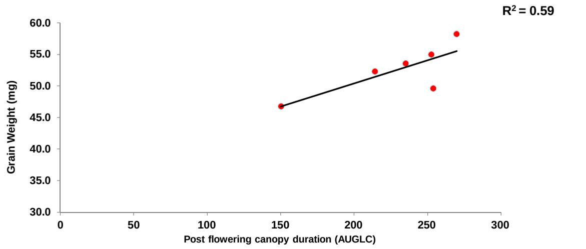
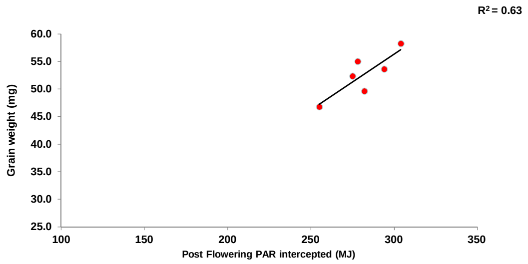
Canopy size + duration on grain weight

Grain weights tended to be greater when green canopy persisted longer in Carlow and Cork

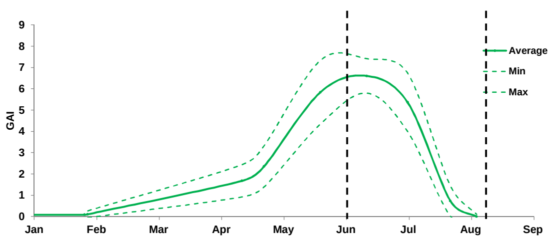


Radiation intercepted on grain weight

Grain weights greater when more radiation intercepted post-anthesis for Carlow and Cork



Canopy development



Post flowering canopy determined by: **Disease Management**
Temperature

Winter wheat yield

Ear Number ← Shoot Survival, Moderate tillering, Plants/m^2 (>200)

Grain Weight ← Radiation, Temperature, Healthy Canopy Size

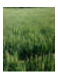
Ear Number	Grain Weight
Shoot Survival	Radiation
Moderate tillering	Temperature
Plants/m^2 (>200)	Healthy Canopy Size

Yield Potential

Yield potential estimation

Temperature

↓

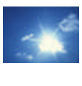


Green Canopy

↓

Light interception %

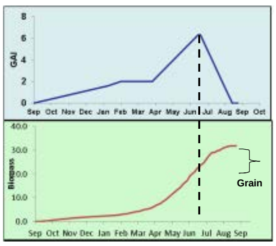
↓



Incident Radiation

↓

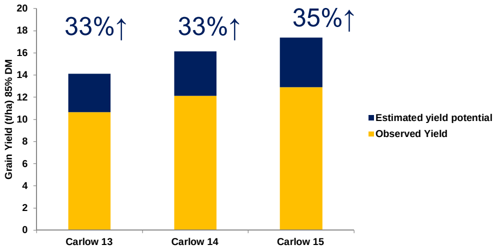
Yield Potential



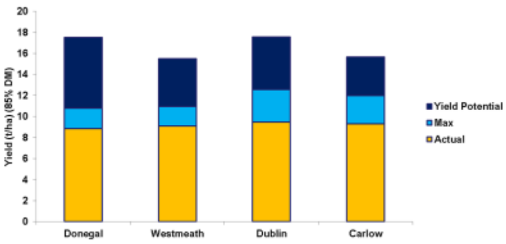
For a given site and season:

Yield of a typical Irish variety if grown without any limiting factors

Was more yield available?



Yield potential 2005-14



- 48-59% increases on the average achieved yield
- 20-38% increases on the maximum reported yields during period

Summary

- Winter wheat monitor crop yields primarily affected by both ear number and grain size
- Crops that achieved high ear numbers 600-650 ears/m^2 had:
  - Plant populations >200 /m^2
  - Moderate tillering pre-GS31(3-3.5 tillers/plant)
  - High shoot survival rate during stem extension period
- Crop that had high grain size (>53g /thousand grains) had:
  - Green area index (canopy) of 6.3-6.7 at flowering
  - Relatively slow canopy senescence (53-55 days)
  - High radiation during June and July

Winter wheat guide

- Summary of monitor crop data and benchmarks for Irish wheat growth and development
- Crop management sections summarising the key husbandry information and research findings
- Launched during Spring 2016
- Available through Teagasc Advisory

Acknowledgements

- DAFM funded project
- Thanks to collaborating farmers for off-centre sites

Teagasc

- John Hogan
- Oak Park Farm Staff
- Summer Interns

AFBI

- Ethel White
- Fiona McHardy
- Shauna McAuley
- Sharon Spratt
- Lisa Black
- Crossnacreevy staff

Thank You

Wheat disease control and resistance issues

Steven Kildea
Teagasc, CELUP, Oak Park

SUMMARY

The ability to attain potential winter wheat yields is dependent on maximising the green leaf duration of the upper canopy during grain filling. Any stresses which reduce the ability of the crop to do so will hamper yields. In Irish winter wheat crops septoria tritici blotch which thrives under cool damp conditions, is always prevelant in Irish crops and is the most destructive of these stresses. Key to mimising the destructive capacity of the disease is to limit infections occurring on the emerging upper leaves from stem extension onwards. To achieve this fungicides are applied at key timings during the growth of the crop. These timings are selected to maximise the protectant and curative capabilities of the applied fungicides. Applying mixtures of fungicides with both protectant and curative properties during stem extension, typically growth stage (GS) 32 when the 3rd final leaf has fully emerged will provide the emerging 2nd leaf protection against future infection, while providing protection and curativity to the 3rd final leaf. Subsequently applications at GS 39, when the final or flag leaf has fully emerged will provide the protection and any curativity required to it, while simulatously topping up protection and/or curativity required on the lower leaves. The final fungicide application at GS65, mid-flowering will top up the protection on the upper canopy while also providing protection of the ear. The success of any fungicide programme is highly dependent on ensuring they are applied as close to these timings as is feasibly possible. Following this the choice of fungicide products will depend on the timing, with applications at GS39 taking precedent as they provide the protection of the leaf layers which capture the most sunlight during grain filling. Currently applications at GS39 should include a multisite, an azole and an SDHI type fungicides. At GS32 the choice of fungicide should be tailored according to disease pressure. Where disease pressure is low the SDHI should be excluded to reduce the potential for selection for fungicide resistance.

In 2015 strains of *S. tritici* with varying levels of SDHI insensitivity were detected in both national population monitoring and following sampling of fungicide trials at Oak Park. The most insensitive of these strains had the mutation C-H152R and displayed reduced sensitivity to all commercially available SDHIs when tested using a microtitre plate assay. They were detected post fungicide application in trial plots at Oak Park at an extremely low frequency. Additional strains with the mutation C-T79N were also detected and displayed reduced sensitivity to all commercially available SDHIs, ableit not to the extent of those with C-H152R. Both strains were able to infect wheat seedings under glasshouse conditions and were not fully controlled by either ¼ or ½ rates of Imtrex when applied protectantly whereas ¼ rate gave good control of wild type Septoria. SDHIs, where used, should always be mixed with an effective rates of azole and multisite fungicides. SDHIs should only be used a maximum of twice per season and should only be used when necessary.

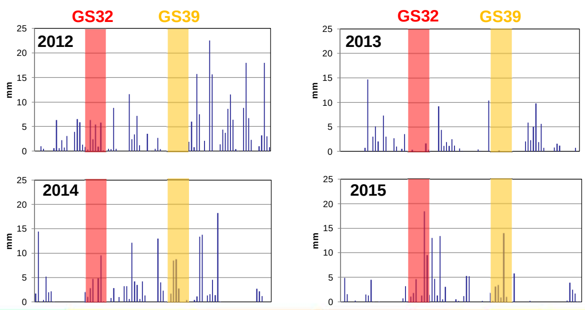
Wheat disease control and resistance issues

Steven Kildea
Teagasc CELUP
Oak Park Crops Research

Keeping upper leaves disease free

Keeping upper leaves disease free

Rainfall April – June @ Oak Park



Septoria tritici blotch

1. Agronomic practises
2. Varietal resistance
3. Fungicides

What is required of fungicides?

The what, where, when and how

- What level of fungicide control is required?
- Where in the canopy is this control needed?
- When will this be best achieved?
- How will this be achieved?

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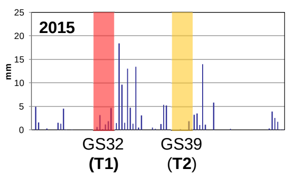
When should fungicides be applied

Need to protect those leaves important to yield



Timing	Growth Stage	Leaf Layer
T0	<30	L4 + below
T1	32	½ of L2, L3, L4
T2	39	L1, L2
T3	65	L1

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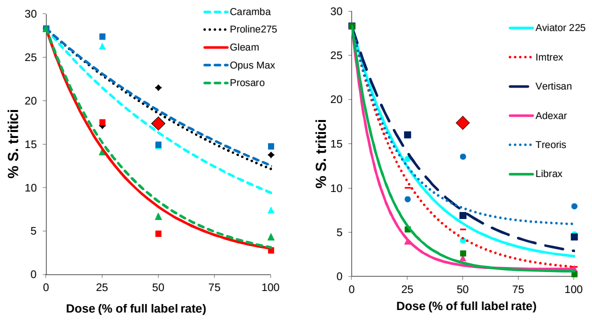
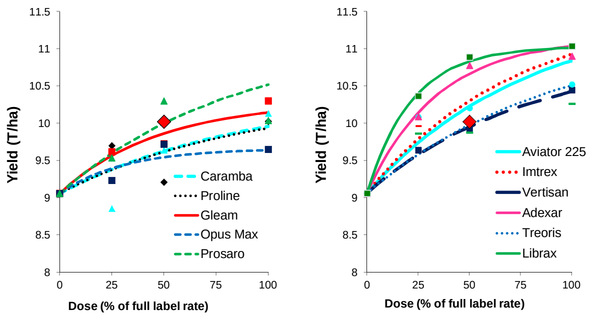
Choosing the best active – disease



Choosing the best active – yield



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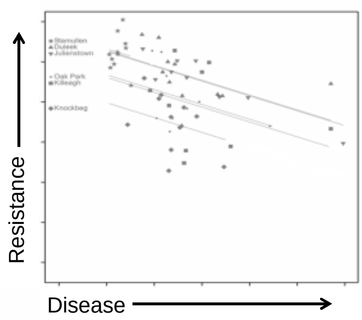
Is fungicide resistance inevitable?



YES!

.....but speed at which it develops and spreads can be manipulated!

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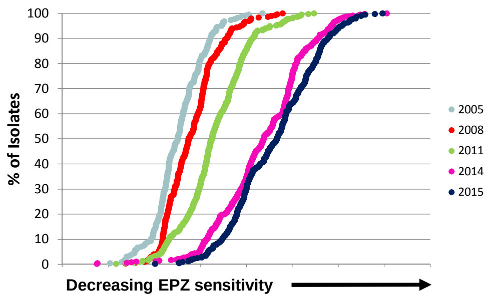
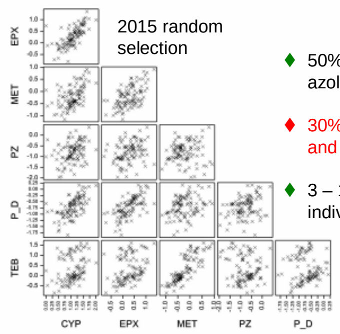
Epoxiconazole sensitivity



Differences between azoles?

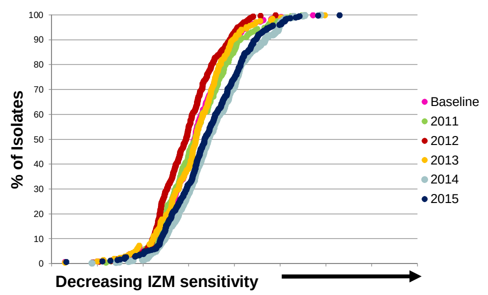


2015 random selection

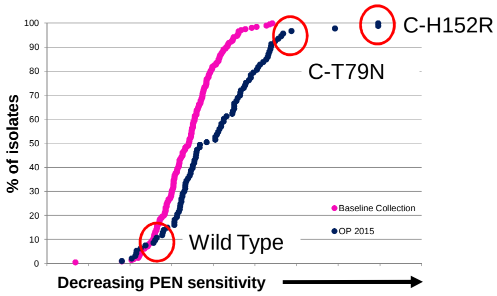
Differences explained

- 50%: cross-resistance between all azoles tested
- 30%: differences between MET/TEB and rest
- 3 – 11% differences between individual azoles

SDHI sensitivity



SDHI sensitivity – Oak Park 2015

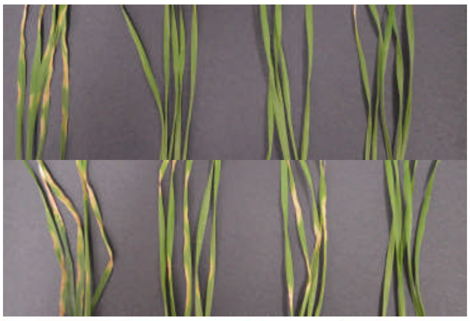


Impact upon disease control - Imtrex

0 ¼ ½ Full

Wild Type

C-T79N

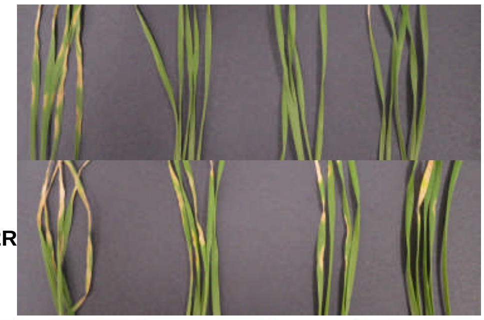


Impact upon disease control - Imtrex

0 ¼ ½ Full

Wild Type

C-H152R



Summary

- Essential to protect upper leaves from disease
- Achieved through correct timings and choice of fungicide
- Continued erosion of azole sensitivity
- SDHI resistance is now present
- Correct usage can still provide needed disease control

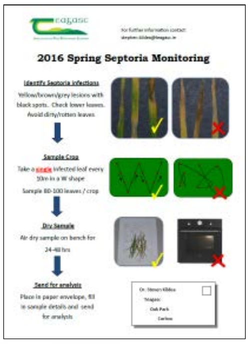
- If isolates selected, they will affect disease control!
- Anti-resistance strategies are an absolute must

Future control must integrate all aspects of crop management

Wheat 2016

Winter	T0	T1	T2	T3
Diseases	• Septoria • (Rust)	• Septoria • Stem Diseases • Rust	• Septoria • Rust	• Fusarium • Septoria
Low Disease Pressure	------	Azole (Mix) & Multisite	SDHI / Azole & Multisite	Azole (mix) +/- Multisite
High Disease Pressure	Multisite & (Strob)	**(SDHI???)** / Azole & Multisite	SDHI / Azole & Multisite	Azole (mix) +/- Multisite

SDHI Resistance Monitoring Spring 2016



- Detailed monitoring of crops
- Specifically for SDHI resistance
- Determine frequency and geographic location
- Samples welcome
- See Poster in foyer for more info

Acknowledgments

Dr. Hilda Dooley
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Jeanne Mehenni-Ciz

Dr. Louise Cooke

Dr. Lisa Black

Leigh McClean

Benefits of participation in tillage discussion groups

Phelim McDonald
Teagasc Knowledge Transfer, Carlow

Gilbert Smyth
Farmer, Bagenalstown, Co. Carlow

SUMMARY

The age old tradition of Meitheal in Irish farming could be looked on as a prototype of today's Discussion Groups. The same principal of honest work for the good of all runs through both.

Discussion groups operating now have clear member objectives, whether voiced or not, and these have been identified in recent years within the Dairy and Beef sectors. The Tillage sector operates discussion groups also, but little formal work has been undertaken to determine similarities with other sectors with respect to participation and benefits. We must for the time being, move forward with the presumption that all farming groups have similar raisons d'etre.

Discussion groups offer farmers a relatively easy and a very practical way of gaining new information, skills, solutions, and technologies. They allow for discussion, adaptation, modification, and improvement to suit each individual's unique farm. Local, national and international developments and trends can be teased out and evaluated and, with good facilitation of such groups, this allows for one of the best methods of knowledge transfer.

The evaluation of benefits of membership of discussion groups offers clear and objective justification for that membership. A 2013 research report published for Teagasc established a 2c/litre advantage for dairy group members, perhaps equivalent to €270/Ha at an average yield and stocking rate. The following year beef group members were reported as having margins up to €95/Ha higher than non-members. Local eProfit Monitor studies have demonstrated margin/tonne benefits to tillage group membership, though further national data is required.

From the feedback I have received from members of various discussion groups over the years it seems that, while every farmer would be very pleased with increased margins and yields, and strives for these, there is great satisfaction gained from the many other and perhaps less expected benefits. Gilbert Smyth, Secretary of Bagenalstown Tillage Discussion Group, speaks in this presentation of opportunities to travel, off-load surplus equipment, enter competitions, receive expert opinion on topics such as soil structure, texture and management and tyre pressure, sizes and compaction. All delivered locally, on farm and co-ordinated by facilitators working for the group. Having said that, the Bagenalstown group are pioneers of financial analysis and they recognise the value of hard facts and have developed their skills to respond to such information. In short, the group is forging a path that could otherwise be daunting if undertaken individually.

The transfer of knowledge to, and within, groups of tillage farmers is set to expand in the coming years, as both Teagasc and the Department of Agriculture, Food and the Marine recognise the overwhelmingly positive impact it has on participants. While such a service will never be demanded by all, there exists tremendous potential to improve extension and uptake of technology by tillage farmers.

Benefits of participation in tillage discussion groups

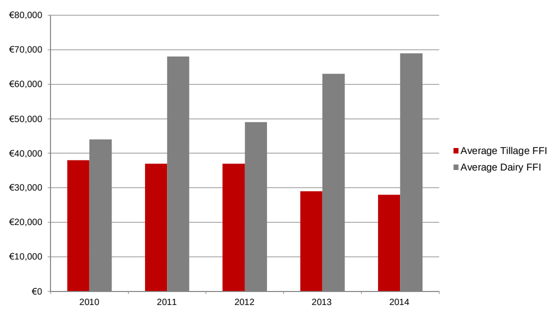
Phelim McDonald
Teagasc Knowledge Transfer, Carlow

Gilbert Smyth
Farmer, Bagenalstown, Co. Carlow

Outline

- Why do Farmers join Discussion Groups
- Some bottom line findings about groups
- A flavour of how groups operate
- A Farmer's experience
  – Gilbert Smyth, Bagenalstown Tillage Group

Tillage incomes Vs dairy incomes

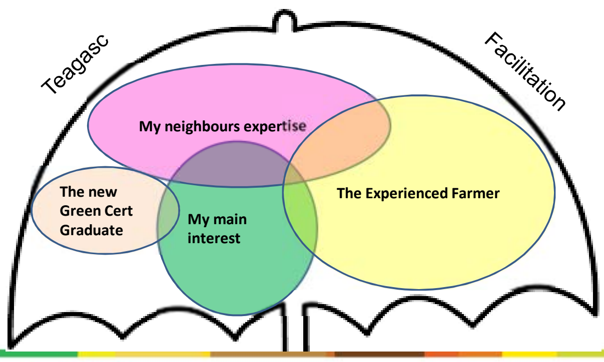


Source: Teagasc National Farm Surveys

So many challenges and decisions

The opportunity of technological advances

Why would a discussion group be of benefit?



Broadmore research findings on dairy & beef discusson groups

Why Farmers Join Groups?

- To get new and updated information
- As a source of new ideas
- Way of learning and problem solving
- To acquire & adopt/adapt new skills
- Addressing specific challenges
- A social outlet
- For payment, through schemes

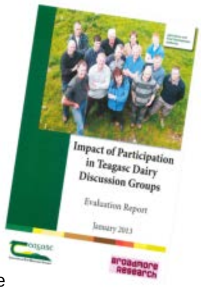
Broadmore research report findings

<u>Compared to non group members…</u>

Better physical performance
55% vs 39% hitting targets

Better financial outcomes
+ 2c/Lt (dairy)
+ €95/Ha (beef)

Better practice adoption
eg. from report = Twice Genomic Bull AI use



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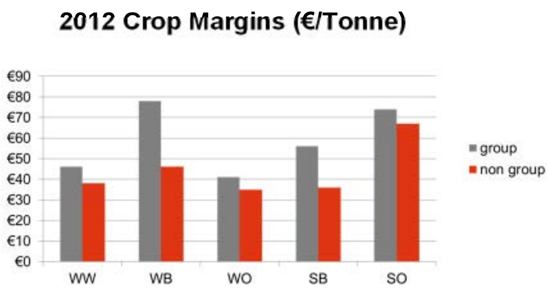
Tillage groups – financial outcomes



eProfit Monitor Results, Carlow, 2012

The Irish Agriculture and Food Development Authority

Tillage groups – practice adoption

For example:

Earlier fungicide application to diseased barley crops

- Group members noticed yield potential not realised
- Loss of tillers identified by the group
- Adjusted fungicide timing
- Peer to peer learning is best

What works well in groups

- Small projects
- Efficiency improvement
- On farm measurements
- New or “Hot” topics
- Demonstration
- Visits outside the group

What works well in groups

- Physical & visual props
- Division of group to tackle an issue
- Benchmarking the group
- Variation of topics
- External speakers
- Follow ups where needed

Other ‘knock on’ advantages

- Farmer/facilitator relationship strengthened
- Better understanding between all members
- More efficient use of time for all
- Improved speaking and listening skills
- Opportunity to undertake training (eg for chairperson)

Essential Roles – Secretary &/or Members

Chairperson
- Elected, helps with agenda,
- Keeps on topic & can speak for the group

Members
- Contributions vital
- Can take on other roles

Facilitator
- Technical backup, leads or takes up slack
- Links to other services
- Directors or conductors role

Starting out in a new group

- Approach a group chairperson/member/facilitator
- Perhaps round up half dozen like minded farmers yourself!
- Commit to confidentiality and truth
- Commit to making regular, positive,open contributions
- Remember DAFM funded KT Groups should soon be available

Bagenalstown tillage discussion group

<u>Gilbert Smyth – Group Secretary</u>

Outline

- Origins of the group
- Milestones & benefits from membership
- The future operation of our group

Bagenalstown group origins

- Formed in 1998
  - Member selection
- Features of the initial operation…
  - Advisor led
  - Lot of information given, less discussion than now
  - Some people a bit quieter
- 'Bedding-in' period
  - Focus on crop husbandry
  - Some initial discomfort
  - Trust builds up all the time
- Did not take long for the group to find it's own feet

Milestones

- Specialised tillage facilitator
- Success in 2003 IFJ competition
- Agronomy focus
- Group attendance at events
- Members machinery auction

Carlow Group opts for machinery ring

- Development of social aspect, family inclusive

Benefits I have gained from membership

- Crop production knowledge – try to be at cutting edge
- Early adoption of more timely field operations
- Yield improvements – fellow members debate the ways
- Reducing Costs – there are always opinions on how to save money
- An appetite for events/tours –travel broadens the mind

Benefits I have gained from membership

Ability to analyse income/accounts

eProfit Monitor
- One of the earliest adopters
- Number of years group reports
- Realise importance of costs

Machinery Cost Calculator
- Involved in it's development
- Cash vs book cost of machinery

Reaction to your figures is the most important thing

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Future direction for the group

Need to re-visit our rules/constitution

Members involved in setting agendas
- Members value the activities all the more
- Group should submit monthly information *in advance*

Bottom line monitoring
- eProfit Monitor has been a feature of the group in recent years
- Never perfect data but well worthwhile continuing

Member turnover
- Successors near to take-over of some members farms
- Some retirement & natural drop-offs

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Summary

- Solid reasons for joining tillage discussion groups
- Solid evidence that members benefit
- Groups should operate as members need

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CROPQUEST: A study of rotations and break crops

Dermot Forristal, John Carroll, Faisal Zahoor
Teagasc, CELUP, Oak Park

SUMMARY

Irish crop production has relatively limited adoption of rotations and break crops, with potential negative impacts on cereal yields, profitability and sustainable production. The Tillage Sector Development Plan of 2012, addressed this deficiency in break crop opportunities and highlighted the need for all including; industry, growers, Teagasc and policy makers to tackle this problem. The Department of Agriculture, Food and the Marine have funded this desk-study project 'CROPQUEST' to initiate action in this area. With an overall aim of identifying further crops and crop markets that would support sustainable and profitable production, the CROPQUEST study in particular examines the role of rotations and broad-acre break crops.

With a previous tradition of mixed farms where grass was the break crop, Ireland's tillage land currently has little rotation with 10% of the cropped area in non-cereal crops. Rotations are needed to improve yields by; providing breaks in disease cycles, better weed control, improved soil structure, and improved nutrient availability. Increased biodiversity and better nutrient capture can bring environmental benefits. In a review of cereal yields following break-crops, while there was realtively little international research of relevance to Irish production, the average increase in cereal yields following the production of a break crop was approximately 10% which concurs with the increase achieved in the long-term systems trial in Knockbeg. Using this yield increase and some savings in production costs where rotations are used, the adoption of rotations can give a useful boost in complete cycle margins amounting to an extra €118/ha per year calculated using low grain prices and average national yields.

A review of possible broad-acre break crops indicated that of the legume crops, beans have the most potential, being well adapted to our environment with good yield potential and an active market as a high-quality protein and starch provider in feed rations. However, breeding and production research gains are still needed and the sector needs to grow a consistent supply to encourage compounders to use more. Lupins and peas will likely remain specialist, small volume crops. Of the oilseeds, oilseed rape has the most potential with good international breeding programmes and a strong commodity market for all that we produce, although native feed and the high-value cold-pressed oil market can absorb some or all of our production. Research is needed to optimise production and disease control in our mild climate to stabilise production. Camelina, although a low-input crop, is likely to remain a niche product. Maize and fodder beet are good break crops but limited by the absence of good inter-farm trading contracts and standards and to some extent, by their late harvests.

Overall, the industry needs to take a longer term view of production and crop choices to ensure the benefits of more robust rotation-based production systems are gained.

CROPQUEST

A study of rotations and break crops

Dermot Forristal, John Carroll, Faisal Zahoor
Teagasc CELUP
Oak Park Crops Research

Outline

- Background to project
- CROPQUEST objectives
- Rotations and their role
- Broad acre break crop options - top seven
- **Challenge:** Maintaining progress

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Background

- Irish Crop Production
  - Limited rotation
  - Few real break crop options
- Recognised in Tillage Sector Development Plan
  - Industry members of Teagasc stakeholders
  - 2012 publication influencing strategy / policy
- DAFM funded this desk-study on rotations and break crops

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CROPQUEST objective

To identify crops and crop markets that will offer more sustainable and profitable production

1. Review crop rotation role and benefits
2. Examine broad-acre break crops and their role in crop production.
3. Examine the scope for high-value crop or crop product options
4. Dissemination: website and publications

Research methods:

- Desk–study: Lit review, economic analysis, workshop

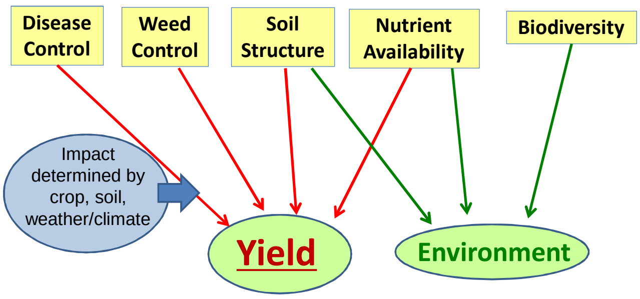
Why crop rotation concern?

- We have low levels of crop rotation
  - In the past: Grass rotations on 'Mixed' farms
  - 1970s - 1980s: enterprise specialisation which continues
  - Loss of beet; other 'breaks' fluctuate
  - Non-cereal break crops: <10% of arable area (excl Maize)
- We have fields in cereals for 15-40 years
- We need Rotations
  - Disease break, weed control, soil fertility
  - More crop / market choices
  - More profitable cereals
  - Sustainable production
- Address protein deficit (EU imports 70% of protein)

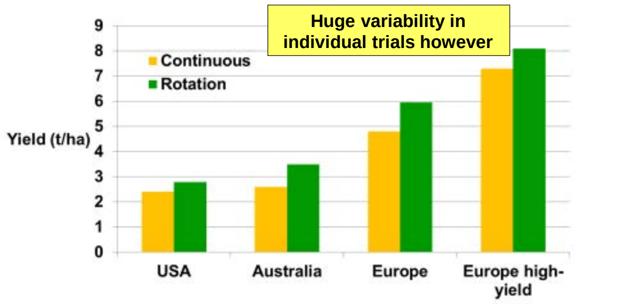
Are break crops beneficial?

- Review of international literature
- Research quite limited
  - Long term and expensive
  - Huge variability
- Systems/rotation trial in Knockbeg

Break crop benefits



Wheat in rotation vs continuous



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Knockbeg systems trial (1996 – 2011)

Winter Wheat

- Continuous wheat
- Wheat following beans
- Wheat following oats

Winter Barley

- Winter barley following Winter wheat
- Winter barley following Spring OSR

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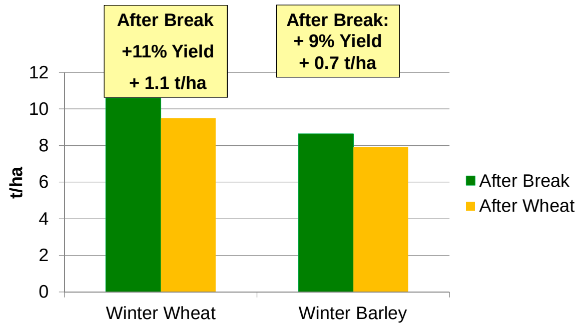
Yields after break crops



Rotation benefit depends on

- Yield benefits brought by break crops (10%)
- Cost savings brought by break crops (€40 N + €40 latitude /ha)
- Absolute and relative prices of crop output

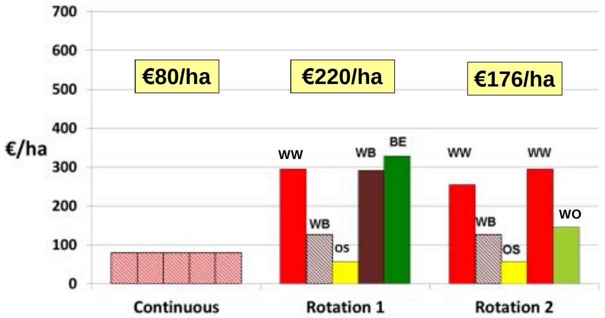
Example: Average crop yields (2008-2015); 2015 costs

Crop	Avg Yield (t/ha)	Prices (€/t)	Prices (€/t)
WW	9.5	150	180
WB	8.9	140	168
WO	8.1	140	168
OSR	4.1	310	372
Beans	5.5	180	216

- Other factors: Yield potential of various crops on specific site
- Value of other benefits: spread workload, weed control, soil structure, etc?

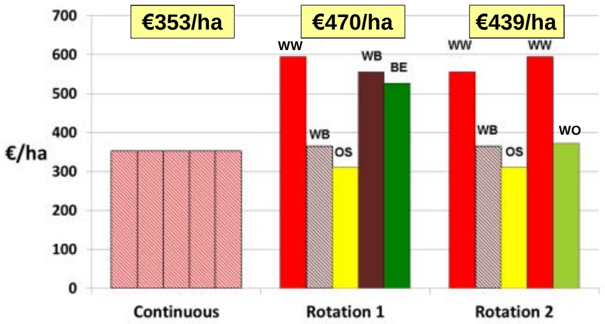
Rotation margins €/ha

(Modest grain prices, 10% yield boost after breaks)



Rotation margins €/ha

(Grain prices +20%, 10% yield boost after breaks)



Break crop options

The top seven !

Field beans

- Legume, native to N.Africa
- High protein (up to 30% protein) – N fixing
- Well adapted to temperate climate
  - Good yield potential
  - However perceived variable performance
  - Suitable for most tillage soils
  - Best on moisture retentive soils (May to June)
- Similar machinery to cereals
  - Does not clash with other operations
  - Later sowing of subsequent autumn crop

Field beans: markets

- Native Animal feed market
  - Excellent source of both protein and starch in feeds
  - Can displace protein imports (soya and maize distillers)
  - Protein imports currently > 1.5Mt annually
  - Native protein (non GM) ideally suited to coarse rations
  - Up to 25% in Ruminant diets; up to 20% in Pig rations
  - Needs consistent production to secure increased inclusion in rations
- Food in human diets:
  - Middle East, Mediterranean region, China and Ethiopia (Favoured breakfast)
  - Irish product is free from Bruchid beetle

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Field beans: rotation

- True break-crop for diseases
- Weed control opportunities
- Legume: fixes N; spares soil N; leaves soil N
- Following crop benefits: typically 10%
- Some soil structure benefits

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Beans: research/development status

- Breeding deficit:
  - Significant compared to Soya. EU awareness increased
- Crop Physiology
  - Limited knowledge of yield formation
- Disease control / Weed control
  - Chocolate spot, Aschochyta, Downey mildew
  - Research deficit and limited control options
  - Limited weed control options
- Crop establishment
  - Early system needed: deep, low disturbance

Teagasc addressing
Now
- Genetic improvement
- Crop Physiology
- Disease control

Future (in addition)
- Crop Establishment

Beans have potential in our climate

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Lupins – (differs from beans)

- Legume, Different types
  - Blue (narrow leaf): 33% Protein
  - White: 40% Protein
  - Yellow: 42% Protein
- Different amino acid profile
  - more suitable for poultry / pigs
  - Interest as healthy protein option in human diets
- More limited yield potential: up to 5t/ha
  - Higher yield types: later harvest
- Best suited to light/medium textured soils
- R+D status: Poorly developed (breeding/agronomy)
- Limited Niche market potential

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Peas: (differ from beans)

- Best suited to light/medium textured soils
- Real harvest risk limits area (lodging at harvest)
- Markets
  - Medium protein (24%) but lysine content similar to Soya
  - Animal feed: Pigs/ Poultry and Ruminants (20 - 30%)
  - Starter diet for young animals and specialist feeds
  - Human food: constant but limited market
- R+D status
  - Breeding limited and multiple end use foci
  - Agronomy: very limited
- Unlikely to grow significantly

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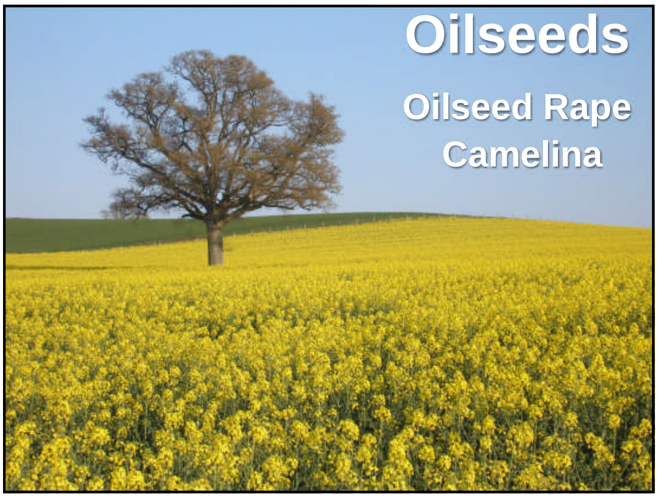

Oilseed rape

- Brassica, oil producing crop
- High protein feed post oil extraction
- Well adapted to temperate climate
  - Good yield potential
  - Variable performance
  - Suitable for most tillage soils
- Similar machinery to cereals
  - Harvest operations do not unduly clash with other crop harvests
  - Facilitates early sowing of subsequent cereal optimising benefit
  - Seeding date can clash with cereal harvest

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OSR : feed markets

- Animal feed market
  - Whole crop used in poultry rations
  - Expeller cake used as protein source
    - Feed value dependent on extraction method
  - Can displace protein imports (soya and maize distillers)
  - Protein imports currently > 1.5Mt annually
    - Soya: 0.42 Mt
    - OSR: 0.29 Mt
    - Sunflower: 0.10 Mt
  - No native large-scale crushing: cake imported

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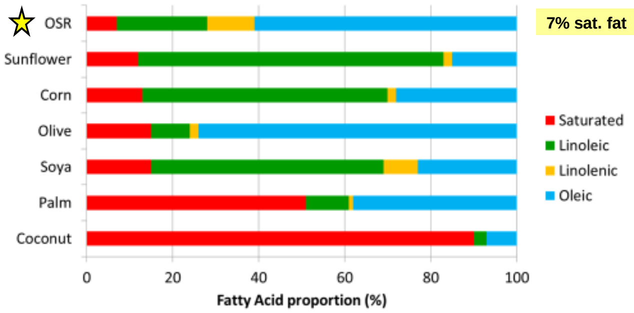
OSR: food markets

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

- 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

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OSR: rotation

- True break crop for diseases
- Weed control opportunities
- OSR autumn growth can trap nitrates
- Following crop benefits: Typically 10%
- Some soil structure benefits

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OSR: research/development status

- Active breeding programmes
  - Agronomic performance (incl. disease resistance)
  - Specific fatty acid profiles for niche markets
- Agronomy
  - Optimisation of crop management
  - Management for Irish conditions needed:
    - Crop establishment
    - Growth / Development + Yield formation
    - Disease control
  - Specific management for niche market oils

Teagasc addressing
Now
- Establishment
- Management (some)
- Disease (some)

Future (in addition)
- Management
- Disease control

OSR has potential in our climate

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Camelina – (Differs from OSR)

- High oil content (42-47%)
- High quality edible oil (38% Omega-3)
- Less stable but stabilisation possible (Omega 3)
- Expeller meal has up to 10% oil and 40% protein
  - When fed to hens: - omega 3 eggs!
- Significant breeding and research deficits
- Limited Irish research
  - low-input crop suitable for our climate/soils
- Current market undeveloped and quite small
  - Some speciality cold-pressed bottled oil potential

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Sugar beet

- Not included in CROPQUEST
- Commercial feasibility and other studies available
- Some Teagasc field studies quantifying yield improvements
  - Approx. 10% yield increase since beet last grown

Maize and fodder beet – quick facts

- Potential as forage crop produced for sale to livestock farmers
- Effective break-crop in rotations, however late harvest
- Good Maize breeding programmes
- Climate limiting (Maize): variable performance and cost/t
- Expensive to grow
- More efficient to harvest and transport than grass
- Fodder beet: difficult to feed and utilise
- Major challenges
  - Developing trading standards (valuing crop correctly for sale)
  - Developing secure contract production to avoid grower shouldering unsustainable risk when grass yields are high

Starch potatoes – quick facts

- 33% of world potato production goes to starch production
- Maize is the largest starch feedstock
- Lots of uses for starch in food and non-food uses
- Germany, France and Netherlands are largest EU producers

- Ireland too small for starch processing and small domestic market.
- Irish production costs too high for starch market

Other crops (specialist)

- Amaranth (protein profile)
- Borage (good oil profile) + Echium (related)
- Calendula - Marigold (dyes and calendulic acid)
- Hemp (fibre)
- Quinoa (nutrition – protein quality)
- Crambe – Abyssinian mustard (erucic acid polymer slip agent)
- Hops (beer)
- Lentils (legume)
- Linseed/Flax
- Poppy (opiates)

Best 3 crops

Development requirements

Three best options

- Field Beans (speciality: Lupins, Peas)
- Oilseed Rape (speciality: Camelina)
- Maize (+/- Fodder beet)

Development / Promotion / Support needed

- To support sustainable production and develop critical mass

This requires

- Medium / longer-term view to be taken by all in sector, not single year!
- Realistic expectations by farmers of break crop and rotation benefits
- Contracts / forward pricing to support production
- Research and technology transfer

Field beans

Current Challenge

- Protein support + exceptional 2015 yields = Market saturation?
  - Coarse rations could take (50%?) more, but not all using beans
  - Can be included in pelleted rations too
  - Beans are an excellent source of protein and energy (O'Kiely 2015)
  - Competing with Maize distillers meal (Similar protein and energy profile; but some differences and MD more variable in analysis (Spiehs et al))

Development

- Contracts/pricing and research to support sustainable production
- For feed industry
  - Encouragement to have extra protein option (another protein bin!)
  - Stable competitive supply of beans
  - Impact of storage/drying and processing on costs and nutritional value

Oilseed rape

Current Challenges

- Variability in production performance and causes
- Large annual fluctuations in area planted
- Expectations
- Largely Commodity market

Development

- Research on crop management and disease control for our climate
- Develop high-value markets (cold-pressed and specific oils) for a proportion of production
- Produce a more accurate costing methodology for rotations and continue to offer / develop contracts/pricing structures to attract growers

Maize and Fodder beet

Current Challenges

- Appropriate contracts not available to protect grower as fodder demand varies. Accurate feed value description also deficient
- Fodder beet consistent but not attractive to users
- Maize performance very variable – seasonal weather impact

Development

- Continue to optimise production of Maize and exploit benefits of varietal development
- Develop contract production systems that ensure growers have a real market, and trading standards to support it

Conclusions

- Need to consider long-term sustainability of crop production
- Rotations: beneficial and economic
  - Dependent on soil/site suitability for individual crops
  - But no panacea either - challenging
- Need to take medium to long-term view
- Must develop break-crop opportunities
  - Beans and OSR most potential
  - Other niche possibilities
  - Maize and Fodder beet have farm to farm potential but constrained
- All actors have a role to play

Bean production and agronomy

John Carroll and Dermot Forristal
Teagasc, CELUP, Oak Park

Farmer's perspective

Ivor Deverell, Geashill, Co. Offaly

SUMMARY

The 2012 Tillage Sector Development Plan produced by the Teagasc crop stakeholders recognised the need for break crops and also for the protein deficit to be addressed. In response, Teagasc Oak Park have initiated several research projects addressing this deficit including a grain levy supported break crop agronomy programme.

The Teagasc/IFA break crop programme currently focuses mostly on beans with research on topics such as varieties, seed rates & sowing dates, early N application, disease and flowering control currently in progress. With just two uncharacteristically good bean growing seasons work, our results to date need to be treated with caution and need many more seasons data to develop a greater understanding of physiology and agronomy. Current work indicates the high yield potential of beans and their potential even when sown later than previously considered acceptable. While higher seed rates gave better yields, more typical disease pressure and high seed costs may not support this in the longer term. Future research plans include genetic/varietal development (under VICCI DAFM funded project), establishment and early growth, and physiological (plant stand, crop canopy) components.

Farmer's perspective: In 2006 after graduating from UCD with a BAgSc in Agribusiness I started farming on the family farm in partnership with my uncle Joe and cousin Jesse. We operate a mixed farm with 140 ha in grassland for our suckler to beef enterprise and 65 ha in tillage. Our main enterprise is the sale of pedigree Hereford stock at our Artisan food shop in Tullamore.

Our midlands location is characterised by heavy clay soils and we often get late frosts. In our tillage enterprise we grow spring barley, winter wheat, winter oats and spring beans which have been included in the rotation and grown successfully, despite some early problems, since 1988. The main reasons for growing beans are margin potential and the effect on soil structure. We follow a fairly standard agronomy programme, sowing with one pass after 0-10-20 broadcasting. The crop is rolled and Nirvana at 4 l/ha is sprayed for weed control. Signum and Rover500 are used for chocolate spot control. A graminicide is used for wild oat control if necessary. Harvesting is usually mid September to late October and we have achieved average yields of 3.05 t/acre over the past 5 years. Bean haulm is used as animal bedding and also as fuel in the farm burner which heats 2 houses.

With field bean area increasing threefold in 2015 it is of great importance to maintain this momentum and develop this native protein source with help from focussed research in bean agronomy and physiology as well as consultation with farmers with many years of expertise in what it takes to grow this crop in Irish conditions.

Bean production and agronomy

John Carroll and Dermot Forristal
Teagasc CELUP
Oak Park Crops Research

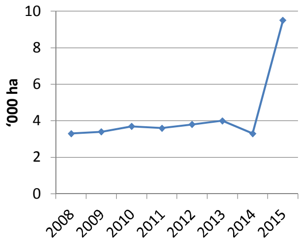
Farmer's perspective: Ivor Deverell

Outline

- Research programme 2014/2015
  - Winter/spring varieties
  - Sowing date and seed rates
  - N & P
  - Disease control
- Farmer perspective
  - Background
  - Why beans?

Drivers for growth

- Greening
  - 3 crop rule
  - EFA
- Need for rotations
  - Continuous cereals
  - Tired soils
- Protein supplement



Field bean agronomy

Variety/ *Genetics*

Crop structure/ Physiology

Seed rate

Disease/ weed control

Yield

Sowing date

Nutrients

Establishment system

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Winter/spring varieties

- 2013/2014
  - 8 true winter + 1 spring
- 2014/2015
  - 7 true winter + 3 spring
  - 10 spring (dwarf/early flowering/black/pale hilum)
- Yield comparisons

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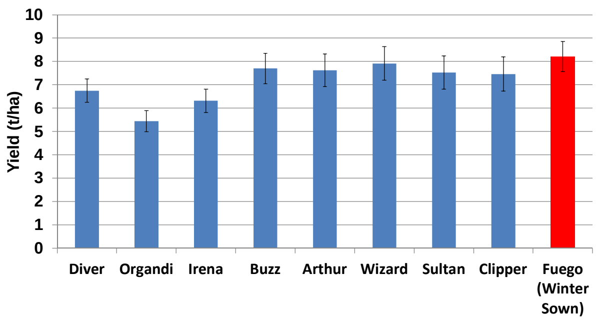
Winter bean varieties 2014



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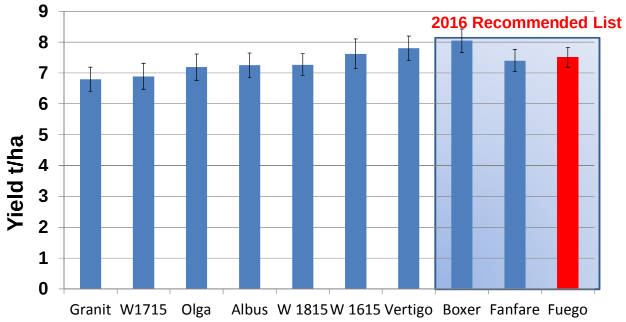
Spring varieties 2015



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Seed rate X sowing date

- 15, 30, 45, 60 seeds/m^2
- 4 sowing dates 2015
- Measurements
  - Establishment
  - Leaves/flowers/pods
  - Height
  - LAI
  - Biomass samples
  - Yield

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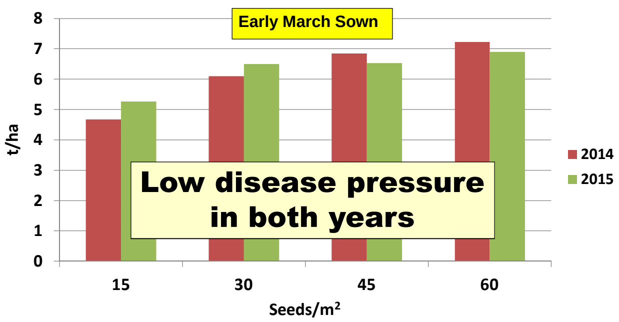
Yield increases with seed rate



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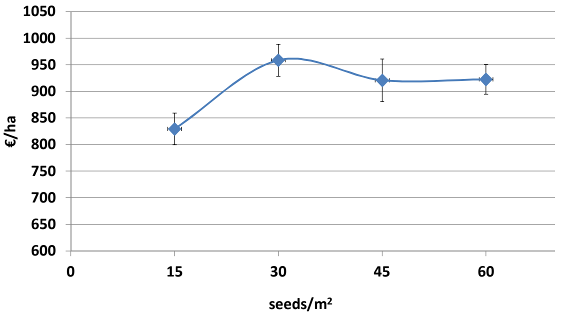
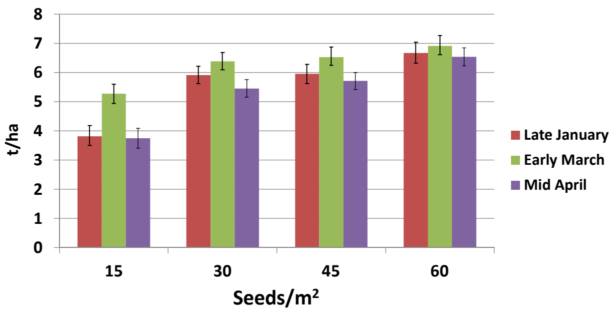
Margin over seed costs



Time of sowing and seed rate 2015



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Early N application

- Conflicting research
  - Some suggest it boosts early nodulation
  - Others suggesting the opposite
  - Not allowed currently under nitrates regulation
- 2014 – 3 rates (0, 20, 40 kg/ha) at each seed rate
- 2015 – 2 rates (0, 40 kg/ha) at 1 seed rate (30/m^2) x 4 sowing dates

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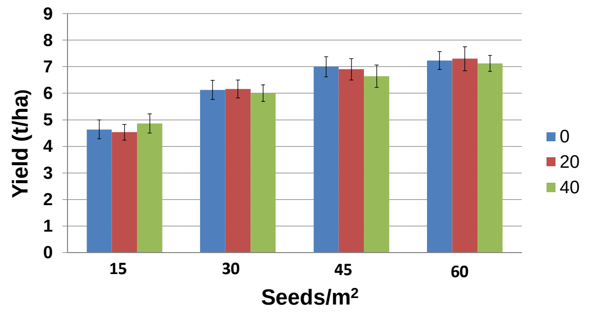
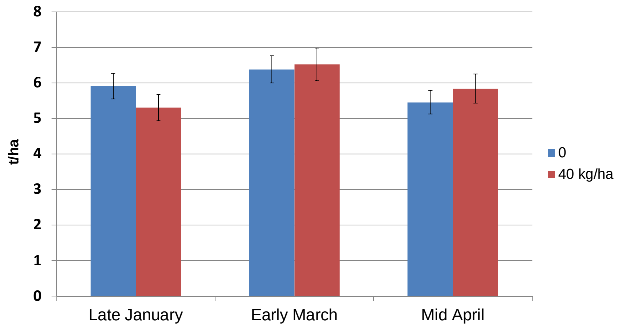
N had no effect on yield (2014)



Again no effect of N on yield (2015)



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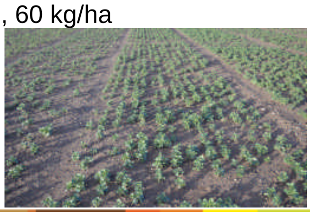
Phosphorus rates and placement method

- Index 1, 2 and 3 soils
- Surface spread (after sowing)
  - 0, 10, 20, 30, 40, 50, 60 kg/ha
- Incorporated
  - 10, 20, 30 kg/ha
- Drilled
  - 10, 20, 30 kg/ha



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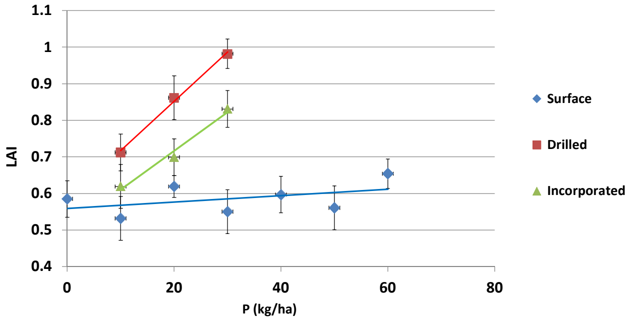
Phosphorus placement method and rate effects LAI (Index 1)



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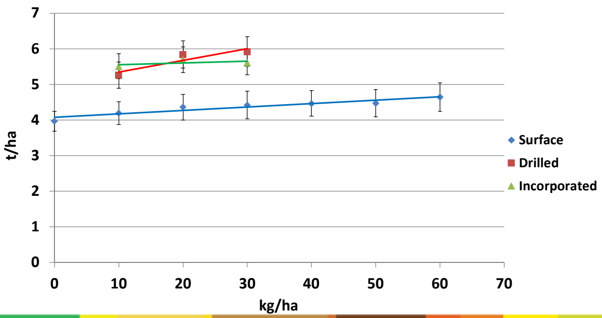
P rate and placement method vs final yield (Index 1)



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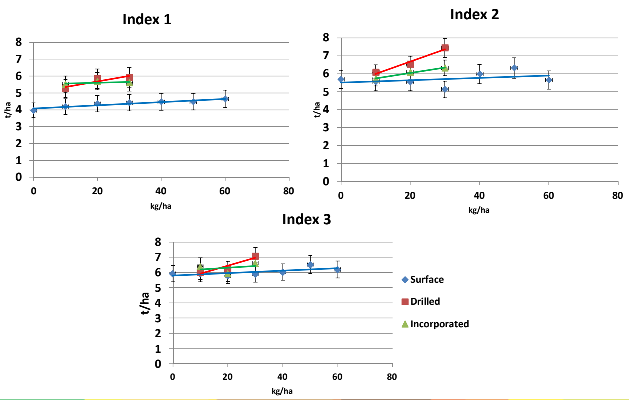

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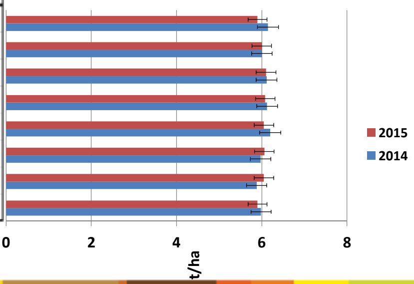
Disease control

- Chocolate spot on spring beans
- Fungicide timing trial (Signum @ 0.75kg/ha)
  - Flowering – T1
  - + 3 weeks – T 2
  - + 6 weeks – T 3
- Both years had very low levels of disease

Fungicide treatment had no effect on yield in 2014 or 2015

	T1	T2	T3
1	✓	--	--
2	--	✓	--
3	--	--	✓
4	✓	✓	--
5	✓	--	✓
6	--	✓	✓
7	✓	✓	✓
8	Control		



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Summary

- Results from 2 high yield/low disease years
- Varietal developments coming on stream
- Seed rate important especially with high TGW
- N had no influence on yield
- Take care on low P sites and drill or incorporate on all sites if possible

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Acknowledgements

- IFA & farmers for paying the grain levy
- DAFM - RSF

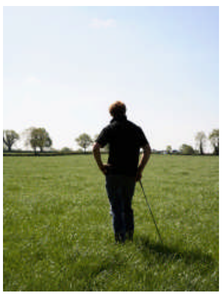
Thank You

Field beans – A farmer's perspective

Farmer: Ivor Deverell
Location: Ballyaville, Geashill Co. Offaly

Our farm

- Farm in partnership with my uncle Joe and his son Jesse
- Farm in two blocks
  - 65 ha tillage
  - 140 ha grassland
- Mixed farm with suckler to beef enterprise & tillage enterprise
- 135 suckler cows – pedigree and cross bred Hereford
- Main enterprise is sale of pedigree Hereford stock with recent growth
- Bring all cross bred cattle through to beef and all finished on grass and home grown cereals



Background

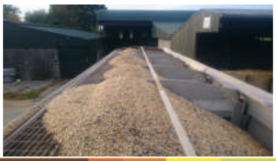
- B.Ag.Sc in Agri Business UCD 2006
- My working week
  - Hereford cattle
  - Tillage field work
  - Irish Hereford Prime beef producer group
  - Artisan food shop in Tullamore selling Hereford beef and Offaly lamb
- Long history of growing field beans on farm

Tillage enterprise

- Midlands location with mainly heavy clay soil type
  - late frosts
  - dry vs wet year
- Crop sown
  - seed & feed spring barley, field beans, winter wheat, winter oats & grass reseeding program on farm
- Rotation varies depending on field
- Incorporate field beans due to yield / margin potential and effect on soil structure

Field beans – Our story

- First grew on farm in 1988
- Ploughed down seed
  - uneven establishment & bird problems
- More importance now placed on seedbed condition than sowing date – does cause late harvesting date occasionally
- Mixed farm allows use of FYM for P & K
- Bean haulm used as cattle bedding



Growing field beans

- Glyphosate pre FYM application
- pH level of 6.5 – 7
  - spread lime previous crops
- Plough & Ring roll
- Broadcast Fert 0-10-20 @ 3 * 50kg/acre
- One Pass Fuego seed 3-4” @ 10.5 –12.5 st/acre
  - seeding rate increased last few years
  - seedbed condition important for sowing depth
  - don’t ignore bird attack problems
  - sowing date depends on seedbed
- Sowed 19th March & Harvested 10th October 2015

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Spray program

- Ring roll & spray pre-emergence herbicide
  - Nirvana @4l/ha immediately
- Mid-flowering fungicide
  - Signum @1kg/ 2 ha & Rover500 @ 1l/ha
  - Chocolate spot & downy mildew diseases
  - Crop height & difficulty spraying
- Manganese & wild oats treatment as necessary

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Harvesting

- Harvested mid Sept to late Oct on farm
- Moisture can be high 2015 – 24%
- Last 5 years yield on farm avg 3.05t/acre
  - 2012 = lowest @ 2.3t/acre - chocolate spot
  - 2015 = highest @ 3.45t/acre - suitable weather

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Renewable energy

- Farm burner used to heat the two houses on the farm with bean haulm

Conclusion

- Suits heavy soil type
- Lime & K requirements important
- Seedbed vs sowing date
- Harvesting - don't panic & look to harvest too early as very weather proof crop
- Low input crop

Notes: