NATIONAL TILLAGE CONFERENCE 2019

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Teagasc

Crops Environment and Land Use Programme

Oak Park Crops Research

Carlow

Wednesday, 30th January 2019

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Programme

09.00	Registration/Tea/Coffee
10.00	Conference Opening
Session 1:	**Challenges ahead and opportunities/response**
	Chaired by Andy Doyle, Irish Farmers Journal
10.15	Playing fields: Level or otherwise ***Guy Smith, Deputy President of the National Farmers Union***
10.45	Economics of the tillage sector in Ireland: Possible Brexit implications ***Fiona Thorne, Teagasc***
11.15	Loss of some, gain of others – current perspectives on crop protection chemistries ***Steven Kildea, Teagasc***
11.40	A farmer/merchant view of the tillage industry ***John Cullen, Tillage Farmer***
12.05	Panel Discussion
12.30	Lunch
Session 2:	**Research snapshots**
	Chaired by John Spink, Head of Programme, CELUP
14.00	Breeding for 'resilience' ***Ewen Mullins, Teagasc***
14.15	Brief Research Updates – Q & A
	The impact of field headlands on crop performance in Irish tillage fields ***Mark Ward, Teagasc***
	Machine turning on headlands: Impact on traffic paths and soil stress ***Brendan Burke, Teagasc***
	Break crop research: An update ***Dermot Forristal, Teagasc***
	Tools to assess soil structural quality in tillage soils ***Giulia Bondi, Teagasc***
	Grass weed control: Utilising all the tools ***Michael Hennessy, Teagasc***
	Herbicide resistance in wild oats: What have we learned? ***Rónan Byrne, Teagasc***
	Oats research – Update ***John Finnan, Teagasc***
15.15	IPM assessment in temperate arable farming (Ireland and the U.K.) ***Steven Kildea, Teagasc***
16.00	Conference Close

Contents

Playing fields: Level or otherwise

Guy Smith
Deputy President of the National Farmers Union

SUMMARY

The NFU are clear that a hard Brexit would, at best, be high-risk for British agriculture and, at worst, it would be catastrophic. Despite an impatience in parts of the British farming community to get things concluded and done, we are adamant Brexit needs to be orderly and incremental. You cannot unpick overnight complex systems of trading agricultural goods within the EU established over a period of forty years. It needs to be thought through and phased, as indeed was the UK's entry into the EEC in the 1970s. Similarly the U.K. will need to renegotiate it's trading relationship with the rest of the world cautiously and agriculture should not be the chip that is most often given away in the negotiations. The WTO is a labyrinthine lions' den where agriculture is usually on the menu. While the livestock sector in both the UK and Ireland looks most vulnerable to the Brexit challenge, we should not forget there are important consequences for the tillage sector.

Meanwhile, alongside and in addition to the challenges that Brexit will bring, arable farmers face wider issues. I'd like to mention just three; the loss of crop protection materials, the fourth agricultural revolution and the need to address environmental objectives such as climate change. We are losing key crop protection materials to the point that EU and U.K. farmers are losing their competitive edge with farmers elsewhere in the world who increasingly enjoy lower production costs due to access to pesticides and plant breeding technologies banned in the EU. Do we need to rethink how we lobby to make the case for agriculture which is both productive and profitable while meeting environmental and social objectives? For instance do we need to be more transparent in how, where and when we use pesticides? Do we need to better demonstrate how farmers routinely use IPM in their crop management?

Farming globally is in on the brink of the fourth great agricultural revolution where digital technology such as: robotics, telemetry, remote imaging, camera technology, GPS will all transform the way farmers produce crops with smarter farming. However without profit farmers will not be able to invest in this new technology and exploit its potential.

In both the U.K. and in the EU there will clearly be a greater emphasis on farm support being delivered through the concept of 'environmental goods' with the role of the farmer being seen as both a food producer and an eco-system service provider. In a world where there is decreasing support for farmers as food producers this latter role clearly presents opportunities for farm businesses to develop new income schemes to keep them financially viable. However we should remember that what defines farming is food production. Farmers first and foremost need to make a profit from food production. This will help us invest in new technology going forward that will keep us competitive in an increasingly globalised world while delivering environmental objectives such as lower carbon and enriched landscapes.

National Tillage Conference

Guy Smith

Deputy President

National Farmers Union

30 January 2018

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Navigating Brexit for British Farming

NFUnited
There's strength in members.

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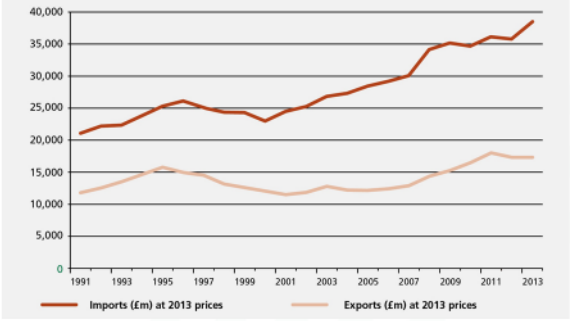
UK TRADE IN FOOD AND DRINK – 2013 PRICES



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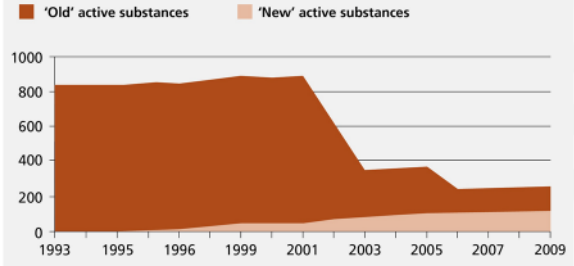
Regulatory Process

Brussels(active ingredients) UK (Products)

DEVELOPMENT OF APPROVED ACTIVE SUBSTANCES

Source: European Commission



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Glyphosate Reauthorisation at EU level


Consider these IPM steps:
1 Farm Appraisal
MORE
2 Soil and stubble Management
MORE
3 Planting
MORE
4 Trapping
MORE
5 Thresholds
MORE
6 Treat if required
MORE
7 Record Keeping
MORE
8 Monitoring
MORE
9 Evaluation and forward planning
MORE


PESTICIDE APPLICATION RECORDS
GEMPLERS
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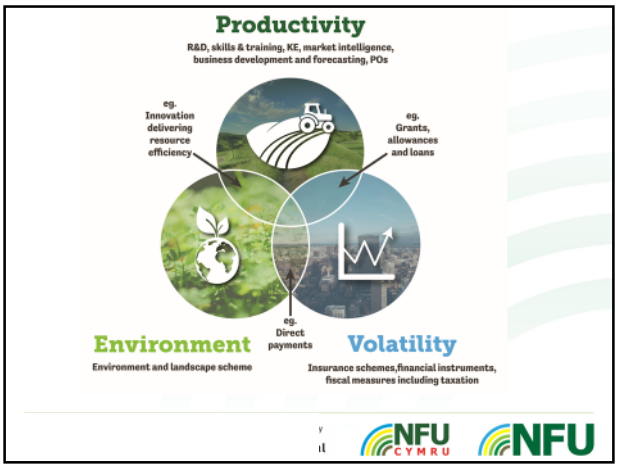
NFU


Productivity
R&D, skills & training, KE, market intelligence, business development and forecasting, POs
eg. Innovation delivering resource efficiency
eg. Grants, allowances and loans
eg. Direct payments
Environment
Environment and landscape scheme
Volatility
Insurance schemes,financial instruments, fiscal measures including taxation
NFU CYMRU
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Economics of the tillage sector: Possible Brexit implications

Fiona Thorne, Trevor Donnellan and Kevin Hanrahan
Teagasc, Agricultural Economics and Farm Surveys Department, Ashtown, Dublin 15 and Athenry, Co. Galway.

SUMMARY

Past and recent trends in relation to economic factors pertaining to the Irish tillage sector indicate a sector that has suffered from input costs rising faster than output costs over the past number of decades. A decline in cereal area associated with relative economic performance has been particularly evident over the past number of years. Over this period dairy farm margins have increased while tillage and other drystock farm incomes have not shown growth in real terms. Specialist tillage farms in Ireland continue to have high reliance on direct payments as a proportion of income.

Looking to the future, this presentation focuses on the most recent analysis carried out by Teagasc economists using the Teagasc FAPRI-Ireland policy modelling tools which has focused on possible implications of Brexit for the Irish tillage sector. Two scenarios were specified: a baseline scenario and a 'No Deal' scenario. The baseline scenario is based on the assumption of no change in trade relations between the UK and the EU (i.e. no Brexit). The 'No Deal' scenario is based on the assumption that the UK leaves the EU on 29th March 2019 without a trade deal with the EU. In the 'No Deal' scenario, the UK imposes tariffs that are equivalent to those in the EU tariff schedule on all imports from the EU and the EU treats the UK as a third country and applies tariffs on imports into the EU that originate in the UK.

The likely economic implications of a 'No deal' Brexit outcome for Irish specialist tillage farms are relatively benign, compared to the other main sectors of Irish agriculture. Ireland is a net importer of cereals and a large proportion of these imports are from the UK. The imposition of tariffs on imports from the UK leads to the replacement of imports from the UK by imports from other EU markets. These imports are more expensive than those imported under the Baseline, and this is reflected in somewhat higher Irish farm gate cereal prices (relative to the baseline). In addition, some inputs that are used in the Irish tillage sector are produced in the UK or sourced from the UK. As a result of a 'No Deal' Brexit, it would become necessary to source inputs from beyond the UK. From an Irish cereal farmer's perspective, this is likely to result in additional trade costs over and above those in the baseline. While the magnitude of these additional trade costs are difficult to quantify, in all likelihood they will lead to upward pressure on the price level of some inputs on the Irish market.

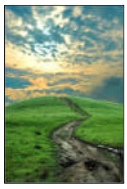
The FAPRI-Ireland farm level model, after accounting for Brexit related inflationary pressures on farm gate cereal prices and input costs, indicates that average net margin on specialist tillage farms could increase by over 10 per cent per hectare in a 'No Deal' Brexit compared to the baseline, by the year 2026. There are key caveats which need to be considered when interpreting these results, such as the possible impact of exchange rate movements, CAP support payments post 2020, structural change and wider economy inflationary factors.

Economics of the tillage sector: Possible Brexit implications

Fiona Thorne, Trevor Donnellan and Kevin Hanrahan
Teagasc

Overview

- **Past trends**
  - From the farm gate perspective
    - Prices, production
  - **Present**
  - Where we are now in terms of the farm gate
    - Relative tillage sector income, viability
  - **Future**
    - Where we are going in terms of the farm gate?
    - Special focus on Brexit



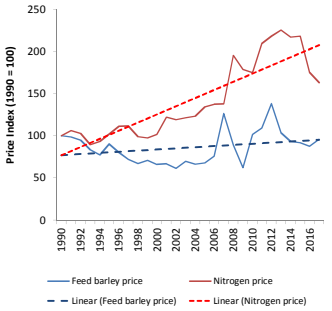
Past trends… at the farm gate

Prices

Production

Commodity price trends

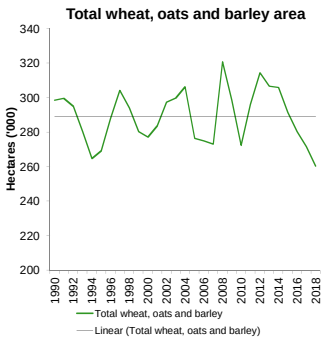
- Output and input prices



- Prices trending upwards
  - Outputs and Inputs
- Items to consider:
  - Must ask is this a trend break ?
    - Certainly more volatility
  - Trend in outputs versus inputs
    - Grain versus fertilisers
    - Inputs rising faster than outputs

Source: FAPRI Ireland

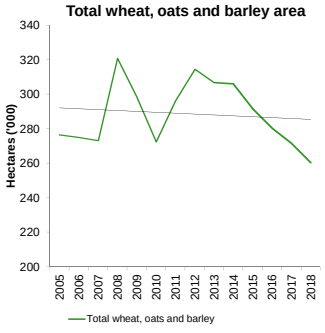
Farm level area of cereals



- Area devoted to cereals is decreasing over the past 3 decades
- But very evident since 2012

Source: CSO

Farm level area of cereals



- Area devoted to cereals is decreasing over the past 3 decades
- But very evident since 2012
  - Decrease in trend line in later time period

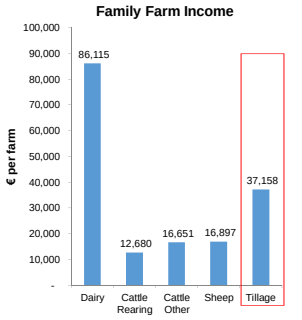
Source: CSO

Present Situation at the Farm Gate in Ireland

Income

Economic Viability

Situation in 2017



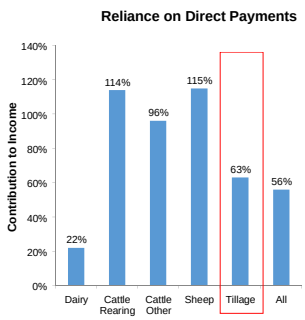
Definition of Family Farm Income
- Return to all owned resources on the farm

Specialist tillage farms in 2nd place, after dairy farms

Some recovery in 2018, but still in 2nd place to dairy

Source: Teagasc, National Farm Survey

Situation in 2017

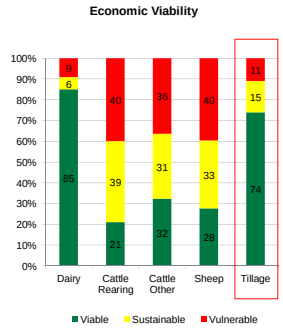


Specialist tillage farms have the highest level DPs

Specialist tillage farms in 2nd place, after dairy farms, in reliance on DPs

Source: Teagasc, National Farm Survey

Situation in 2017



Definition of Economically Vulnerable
- Non-viable and non-sustainable

Definition of Economic Sustainability
- Farms that are not economically viable, but have an off-farm income source, from operator or spouse

Definition of Economic Viability
- Family Farm Income is sufficient to remunerate family labour at the minimum agricultural wage and provide a 5% return on non-land assets

Source: Teagasc, National Farm Survey

Baseline versus 'No Deal'

Baseline

Year: 2026

No Brexit

Assume all trade relations remain the same

Assume no price changes due to the policy

'No Deal'

Year: 2026

'No Deal' Brexit

WTO Tariffs apply on imports and exports from/to UK

Non-tariff barriers to trade also assumed

	Bound WTO tariff rates on imports*
Wheat	€95
Barley	€93
Oats	€89

*Except for the preferential rates agreed for certain TRQs

Farm level Brexit analysis

- To examine the potential impact of Brexit for Irish agriculture
  - Impact on farm incomes *(average* position)
  - *Distributional* impact on incomes
- Methods
  - Food Agricultural Policy Research Institute (FAPRI) Ireland model
  - Teagasc, National Farm Survey (NFS) data
  - Simulate the impact on Irish prices and farm level income
    - Looking at our four principal sectors
    - Beef, dairy, sheep and tillage
    - Analysis conducted at the system level
      - Important for understanding results
- Assumptions
  - Static analysis
  - Note on 'what ifs'?

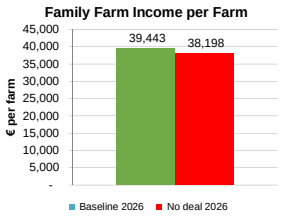
Price Assumptions,
Baseline versus 'No Deal' by 2026

Factors affecting relative price change:

- Status of the sub sector:
  - Net importer or exporter of a product
- Trade Competitiveness
  - Size of the tariff if applied
  - Price competitiveness
- Trade Openness
  - Amount of trade with the UK
- Non-Tariff Barriers to Trade (NTB)
  - Low digit per cent increase

Source: FAPRI Ireland, aggregate model

FFI Specialist Tillage Farms
Baseline versus 'No Deal', 2026

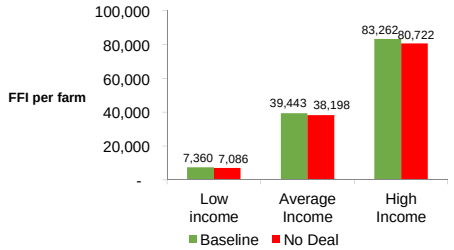


Relative income change:

- Remember looking at system changes (- 3%)
- Importance of beef & sheep on tillage farms
- Most severe price changes for beef output produced by tillage farmers
  - Implications for structural change
- Input prices affected:
  - Seed
  - Concentrates
  - Non tariff barriers to trade

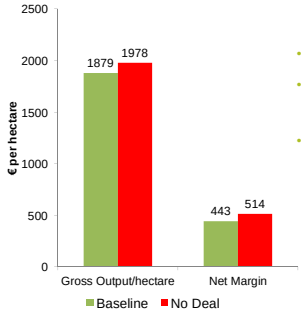
Source: FAPRI Ireland, farm level model

Distribution of Income, Specialist Tillage Farms



Source: FAPRI Ireland, farm level model

A brief look at cereals only……
Winter wheat (Economics per ha.)



Relative income change:

- NOTE: looking at enterprise level here
- 7 per cent system increase (last slide) becomes a 16 per cent net margin increase
- Part of the system income effect diluted by large decrease in beef output

Source: FAPRI Ireland, farm level model

Other 'What ifs?'

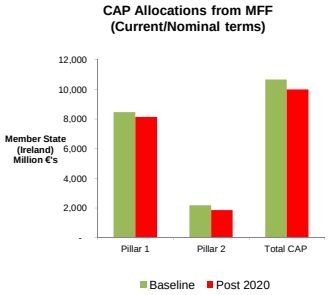
- **Other key unknowns for the 'No Deal' scenario**
  - Long list…..
  - Exchange rate movements
  - Nature of the modelling exercise
    - Partial equilibrium model versus general equilibrium model
    - Economy wide impacts of Brexit on GDP
  - Other output and input price changes such as straw receipts
  - Structural change
    - Assumed price changes in this exercise do include interaction between sector
    - Key assumption is that this a static analysis at the farm level
    - BUT structural change is extremely difficult to model

Other 'What ifs?'
Other future trade policy scenarios

- **What about a Free Trade Agreement (FTA) scenario?**
  - NTB to trade still to apply to imports
- **What about a Unilateral Trade Liberalisation (UTL) scenario?**
  - UK decides to liberalise trade and reduce/ remove its import tariffs
  - For the tillage sector, a net importer of cereals
    - Without a bilateral agreement, WTO tariffs still apply on exports from the UK to Ireland

Other 'What ifs?'

The future of the CAP



- **CAP Policy Post 2020**
  - Previous Brexit analysis included changes
- **Extra demands on CAP post 2020**
  - Various different sources
  - Brexit, secuity, migration etc
- **Current figures are preliminary**
  - But suggestive
  - Matthews (2018)
  - 6% reduction in CAP supports to Ireland

Source: Matthews, 2018

Conclusions

- **Past**
  - Long term trend of input prices rising faster than output prices
  - Productivity improvement is the key to remaining competitive
- **Present**
  - Specialist tillage farming FFI 2nd place to dairying
- **Future**
  - Key focus on Brexit
  - System level specialist tillage FFI to increase in a 'No Deal' scenario
- **BUT,**
  - What about exchange rates, structural change, wider economy impacts, CAP
- **Nothing to write home about in terms of positive take home messages**

Loss of some, gain of others – current perspective on crop protection chemistries

Steven Kildea
Teagasc, CELUP, Oak Park

SUMMARY

Irish cereal farms are amongst the most productive globally. Combinations of plentiful rainfall throughout the growing season and long day lengths during the grain filling period ensure Irish crops have the potential to produce exceptionally high yields. Unfortunately these same conditions are ideal for the development of cereal diseases, insect pests and weeds. To minimise the impact these pests have on Irish cereals pesticides in the form of fungicides, herbicides and insecticides are routinely applied. Whilst alternative control measures, including cultural control and varietal resistance are also utilised, current systems remain heavily reliant on the application of pesticides to achieve yield potentials and maintain profitability. Unfortunately, were the availability of current crop protection chemistries to change, this over reliance could potentially pose a serious threat to the sustainability of Irish cereal production systems.

Within the European Union all crop protection chemistries must meet specific criteria set out by Regulation 1107/2009, such as potential impacts on human and environment health, prior to their authorisation. This includes all new chemistries, but also those previously authorised under past Directives. It is anticipated that in the coming year(s) as some of the currently available chemistries come up for review they will not past the strict criteria of 1107/2009 and as such will no longer be available for use on European crops. In addition, even where certain chemistries are approved for use, their use will be restricted to specific crops. In addition to these regulatory restrictions the development of resistance in all three pest categories is further reducing the availability of effective crop protection chemistries. It is therefore increasingly important to ensure all means that reduce resistance development and spread are implemented. To achieve this and effective control, increased emphasis must be placed on the integration of all control practises.

To determine what the impact of these changes (resistance and loss of chlorothalonil) may have on production a review of Teagasc winter wheat trials investigating Septoria control was undertaken in 2016 and 2017. Based on current fungicide chemistries it is estimated that the potential loss of chlorothalonil would result in a significant reduction in net margins, reflecting a significant loss in disease control and yield. To minimise these potential reductions increased emphasis must now be placed on varietal resistance, agronomic practises including sowing date, but also careful consideration to fungicide application timing and fungicide choice.

Loss of some, gain of others-
Current perspectives on crop protection chemistries

Steven Kildea
Teagasc CELUP
Oak Park Crops Research

Diseases, pests and weeds

Diseases, insect pests and weeds have the potential to significantly reduce the quality and quantity of Irish cereal yields

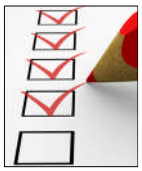
The current dilemma - the 3 what's

1. **What's driving changes in available actives?**
   - Regulation 1107/2009 (SUD 2009/128/EC)
   - Resistance development (diseases/pests/weeds)
2. **What's the likely impact?** *(Septoria example)*
   - What's actually working?
   - What's coming down the line for disease control?
3. **What's the solution?**
   - Integrated Pest Management

What's driving these changes?

REGULATIONS

REGULATION (EC) No 1107/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 21 October 2009
concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC



Increased criteria within the authorisation of active substances
+
Hazard *v.* Risk based assessment
=
Reduced number of actives available

Future availability - 'Cereals & OSR'

Cereals & OSR	Fungicides	Herbicides	Insecticides
Not Approved	Carbendazim	Diquat	
	Flusilazole	Flupyrsulfuron	
	Picoxystrobin	Flurtamone	
	Propiconazole	Ioxynil	
	Quinoxyfen	**Isoproturon**	
	Thiram	Tepraloxydim	

Potential to have significant impacts on production

Future availability - 'Cereals & OSR'

Cereals & OSR	Fungicides	Herbicides	Insecticides
Not Approved	Carbendazim	Diquat	
	Flusilazole	Flupyrsulfuron	
	Picoxystrobin	Flurtamone	
	Propiconazole	Ioxynil	
	Quinoxyfen	Isoproturon	
	Thiram	Tepraloxydim	
Approved, <u>but no longer</u> for cereals & OSR		MCPA	**Clothianidin**
			Cypermethrin
			Methiocarb
			Pirimicarb

Potential to have significant impacts on production

Future availability - 'Cereals & OSR'

Cereals & OSR	Fungicides	Herbicides	Insecticides
Not Approved	Carbendazim	Diquat	
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	Picoxystrobin	Flurtamone	
	Propiconazole	Ioxynil	
	Quinoxyfen	Isoproturon	
	Thiram	Tepraloxydim	
Approved, but no longer for cereals & OSR		MCPA	Clothianidin
			Cypermethrin
			Methiocarb
			Pirimicarb
Non-approval already proposed	**Chlorothalonil**		Dimethoate
			Indoxacarb

Potential to have significant impacts on production

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	Propiconazole	Ioxynil	
	Quinoxyfen	Isoproturon	
	Thiram	Tepraloxydim	
Approved, but no longer for cereals & OSR		MCPA	Clothianidin
			Cypermethrin
			Methiocarb
			Pirimicarb
Non-approval already proposed	Chlorothalonil		Dimethoate
			Indoxacarb
Likely in next 1-2 years	Cyproconazole		
	Epoxiconazole		
	Fluquinconazole		
	Tebuconazole		

Potential to have significant impacts on production

Future availability - 'Cereals & OSR'

Cereals & OSR	Fungicides	Herbicides	Insecticides
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	Thiram	Tepraloxydim	
Approved, but not for cereals & OSR		MCPA	Clothianidin
			Cypermethrin
			Methiocarb
			Pirimicarb
Non-approval already proposed	Chlorothalonil		Dimethoate
			Indoxacarb
Likely in next 1-2 years	Cyproconazole		
	Epoxiconazole		
	Fluquinconazole		
	Tebuconazole		
???		Metazachlor	
???		**Glyphosate**	

Potential to have significant impacts on production

Future availability - Vegetables

Vegetables	Fungicides	Herbicides	Insecticides
Not Approved*	Iprodione	Dichlobenil	Pymetrozine
	Fenamidone	Linuron	
		Glufosinate	
Approved, but no longer for Veg			Methiocarb
			Pirimicarb
Non-approval already proposed	Chlorothalonil	CIPC (sprout suppressor)	Indoxacarb
Likely in next 1-2 years	Tebuconazole		
???		Metazachlor	
???		**Glyphosate**	

*** In addition to those also not approved for cereals & OSR**

Future availability – Potatoes/beet

Potatoes/Beet	Fungicides	Herbicides	Insecticides
Not Approved*	Iprodione	Dichlobenil	
	Fenamidone	Linuron	
	Maneb	Glufosinate	
Approved, but no longer for potatoes or beet			Methiocarb
			Pirimicarb
			Clothianidin
Non-approval already proposed		CIPC (sprout suppressor)	Ethoprophos
		Desmedipham	
		Phenmedipham	

*** In addition to those also not approved for cereals & OSR**

Resistance also indirectly removes actives

Usage = Resistance

Fungicides have a limited life span

Almost inevitable resistance will emerge

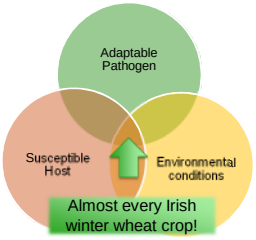
Need to minimise exposure as much as possible

Resistance management is your responsibility

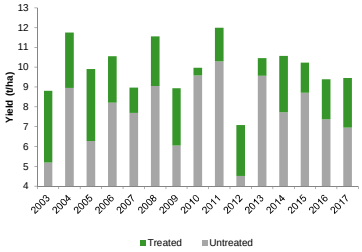
teagasc

What does this all mean?

Septoria tritici blotch

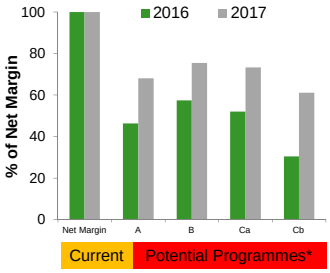


In most seasons fungicides provide >25% yield increase



- Teagasc trials data set 2003-2017
- Significant yield increases P<0.001

Loss of CTL – potential problem?



* Based on current chemistry & fungicide resistance status of Irish *Z. tritici* population

Even where alternative multisite & increased doses of fungicides used:

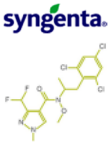
- Significant reductions in net margins
- Profitability seriously eroded on marginal / less productive land
- Impact likely to be greater in Ireland due to high disease pressures

Managing future actives?

CORTEVA agriscience

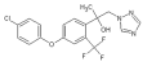
Inatreq™ (2020) **Adavelt™ (2024?)**

syngenta



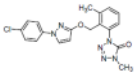
Adepidyn ™ (2022?)

BASF We create chemistry



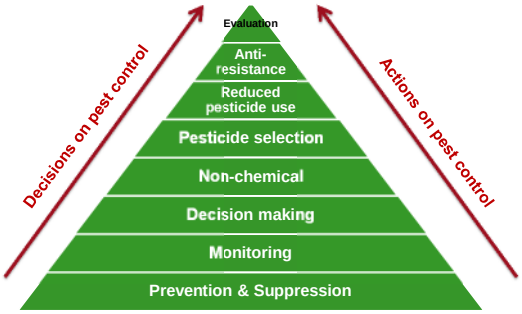
Revysol® (2020)

BASF We create chemistry SUMITOMO CHEMICAL



Pavecto ® (2022)

Optimising pest management strategies (IPM)



Conclusions

- Loss of important actives expected in near future
  - Regulatory pressures
  - Increased development of resistance
- New actives (fungicides) are on the horizon
  - Resistance management will be essential
  - Reduced tools to achieve this??
- **Must increase attention and adoption of IPM practices across all arable systems - collective approach needed!**

Acknowledgements

Teagasc Crops Research

Teagasc Tillage Specialists

Pesticides Registration and Control Division

A farmer/merchant view of the tillage industry

John Cullen
Tillage Farmer

SUMMARY

John Cullen with his brothers, Francis and Stephen, run a large tillage operation in south Wexford. John also runs an Agricultural Merchant business, John Cullen Grain Ltd. which he started 14 years ago. John was awarded the Zurich Insurance Tillage Farmer of the Year in 2018.

John first started farming 38 years ago with his father and brothers. They farmed 161 hectares (400 acres) of which two thirds were rented. The tillage operation consisted of a mix of spring malting and feed barley. The business has grown over the years and now stands at a little over 850 hectares (2,100 acres). Cropping has also changed on the farm with winter cereals forming the back bone of the production. John tries to focus on first wheats (5 year Av. yield 10t/ha) as much as possible with approximately one third of the tillage area dedicated to this crop. Winter barley (5 year Av. 9.1t/ha) takes up approximately one third of the sown area and is mainly sown as a 2nd cereal. John is a huge advocate of break crops and has as close to one third of the farm sown to either winter oilseed rape, winter oats or beans.

Labour steadily became a problem on the farm and John decided to change to a "Min-till" establishment system in 2018. Almost all crops were planted using this over the past 2 years but John recognises the system's short comings in relation to grass weed pressure and utilisation of organic manures. The farm runs a very efficient machinery outfit with only one combine completing the entire farms harvest each year. The total machinery cost across the farm in 2018 are €271/ha (€110/ac).

Following the death of John's father, 14 years ago, the farm was reorganised and John started trading grain for 6 local farmers, which was the starting point of his agricultural merchant business. The business has grown steadily and now employs 10 people, with storage for 20,000 tonnes of grain and the recently installed coarse ration mill now processes approx. 80% of all grain stored.

There are many challenges for John as a farmer and a merchant. Low profitability from tillage crops is the most pressing issue for John and his customers. Consistency of yields from cereals but especially from break crops is challenging. John is working hard to improve soils by increasing soil indexes, applying organic manures and being more patient around field operations (partially forced by the conversion to min-till). The potential loss of key chemistry is of particular concern and may adversely affect the viability of many crops on the farm. In the longer term, succession issues may arise but can only be dealt with as time goes by. Identifying and acting on opportunities has been a hallmark of John's management of his businesses and he is confident there are opportunities to improve even further. Increased farmer co-operation is necessary to control machinery costs, which are too high on tillage farms, and this co-operation can help to cope with lack of available labour at peak times. Share Farming may be a viable way forward for many. Realising the true potential of straw should also be examined more closely.

John is keen on farm trials and more should be done by farmers in this area. For larger farms, increased precision is needed, which is an area John intends to develop on the farm by utilising yield mapping and improving field recording/analysis . John is confident that tillage will remain an important part of the agriculture mix in Wexford. Tillage is profitable at the moment but farmers need to avail of and act on the latest information/research from Teagasc (and elsewhere) to remain profitable.

A Wexford farmer/merchant view of the tillage industry

JOHN CULLEN GRAIN LTD

John Cullen

Farm background

- Started 38 years ago
  - 400 acres (1/3 owned)
  - Tillage and some beef (Spring Malt and Feed barley)

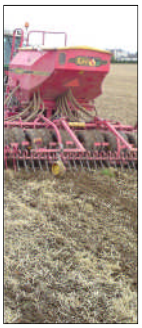
- Farm is now 2,100 acres
  - With my brothers Francis and Stephen
  - Large proportion Long term leased and some share farming
  - Mostly within a 15 mile radius

Farm background

- Our rotation now…
  - $^1/_3$ Winter Wheat , $^1/_3$ W Barley, $^1/_3$ break crops (WOSR, W oats and beans) some spring barley
  - Rotation typically
    - W barley, WOSR, W Wheat, W Barley, Break or S barley
    - Not totally set but aim to maximise first wheats
- Yields (5 year averages)

Crop	Yield (t/ac)	Crop	Yield (t/ac)
W Wheat	4.0	WOSR	1.6
W Barley	3.7	Beans	3.4
W Oats	3.4		

Farm machinery policy and costs



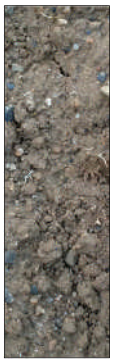
- Changed to “Min-till” in 2017
  - Changed needed due to labour availability
- System used to establish all crops in 2018
  - Patience is needed!!
  - Grass weeds (S Brome)
- Total farm machinery costs €271/ha (€110/ac)
  - Of which Diesel cost €30/ac
  - Newish machines with low repairs bills

Merchant business

- Started 14 years ago
  - Ro-organisation following family death
  - 6 farmers – buying and selling grain
- Business now has
  - 10 staff, with storage for 20,000 tonnes
  - Feed mill in 2017 – Add value to grain - utilise 80% of purchased grain
    - Prompt – excess beans & oats … now necessary part of ration!

Farm challenges

- Profitability in general
  - Increase break crop consistency
- The larger the area more yield appear to dip
- Soils – maintain yield potential
  - Struggling to keep P&K index’s
  - Utilising OM but it’s difficult (especially with min-till)
    - Conscious of neighbours concerns!
    - Utilise in winter rotations
- Loss of chemistry
- Improve Labour efficient tasks
  - Liquid N – a solution??



Industry challenges

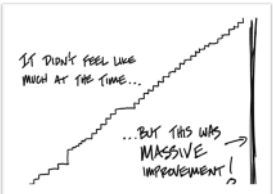
- Access to land difficult
- Can tillage farmers work with dairy farmers
- Overcome and react to emerging ag-chem resistant
- New chemistry slow coming
  - At what cost?
- Is there efficiencies in chemistry industry?
- Cheap imports – are EU farmers production costs lower?
- Beef industry is important to the tillage industry

Merchant business challenges

- Finance to support expansion
  - Existing costs and new progress
- Expansion – opportunities exist but..
- Down the road
  - Succession – both farm and merchant business

Incremental change

- Many small steps, with an eye on detail, will improve profitability
- Teagasc research and supports
  - Very relevant & timely information available
  - Open Days/events excellent and everyone serious about tillage should attend
  - Support by my advisor (John Pettit)

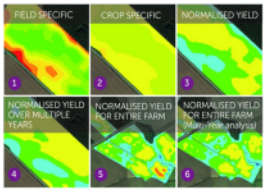


Opportunities

- Profitability
  - Increased share farming (most tillage farms are over mechanised)
- Can we do more with straw- should be a valuable income stream
- Milling wheat?
- Lowering costs – Establishment costs, liquid N, cover crops, fungicides, etc.

Opportunities

- More precision needed to improve average yields
  - Yield monitoring
  - Improve field/task recording
  - Analyse the results and look for trends
- Increased on-farm trials
  - Tramlines, split fields
  - Need to be more open and share experiences - help everyone to improve



Closing remarks

- Tillage farms can be profitable and sustainable
- Need to change constantly to develop business
- Think positively
  - Control what you can control – ignore the doom and gloom

Thanks for listening

Breeding for 'resilience'

Ewen Mullins
Teagasc, CELUP, Oak Park

SUMMARY

Ireland has a climate that bestows high yield potential for its primary tillage crops. Yet the maritime conditions that maintain yields also support the prevalence of crop diseases. Presently controlled using pesticides, the continuation of this approach is unsustainable due to the evolution of pesticide resistance/insensitivity coupled with EU legislation, which will significantly impact on pesticide availability in the medium to long term. In parallel, the need to mitigate abiotic stress is equally important, as demonstrated by the drought conditions of 2018. In the face of these challenges, an increased emphasis on breeding for varietal resilience to biotic and abiotic stresses will be an essential action to support sustainable tillage farming in the future.

Focussing on biotic stress, two significant cereal diseases in Ireland are *Septoria tritici* blotch (STB) in winter wheat, and Fusarium head blight (FHB) in all cereals. A major problem in achieving the goal of developing varieties with increased resistance to these diseases is the simple fact that Ireland has no indigenous cereal breeding programmes. Consequently, we rely on varieties bred specifically for Great Britain and northern Europe. While varieties from such breeding programmes have many of the required agronomic properties for production in Ireland, STB (and to some extent) FHB are not necessarily the main disease pressure in the primary target regions for these varieties, and consequently, few varieties exhibiting high levels of resistance to these diseases are available.

While it is not feasible to re-establish commercial scale breeding programmes for cereals in Ireland, an alternative approach is to develop tools that would enable current (UK and European) cereal breeders supplying the Irish market to select for resistance to specific diseases more efficiently. In collaboration with national and international academic/industry partners, large scale lab and field studies have been underway through projects such as the DAFM funded VICCI. Through this initiative individual breeding lines have been identified from breeding populations and collections of heritage varieties which have not previously undergone extensive field assessments. Our goal is to exploit this knowledge via genetic improvement strategies with commercial breeders so as to lead to the development of resistant phenotypes to both diseases in breeding programmes.

Breeding for ‘resilience’

Ewen Mullins
Teagasc CELUP
Oak Park Crops Research

Overarching challenges to the sector

- Neo-nics, Bravo ?
- Glyphosate ?

- Dairy expansion
- Land use

- Erratic climate
- Lack of genetic resilience

Ambition is to deliver solutions that:
- support the reduction in productivity costs
- future proof cropping systems

Innovation	• **Science based solutions through to practise** • **Sustainability and profitability of sector** • **Promote optimum land use** • **Diversification of crop regimes**
Excellence	• **Recognized internationally for the quality and relevance of our research and outputs**
Partnership	• **National/international collaborations** • **Expand the national / international profile of the department in support of stakeholders**

Virtual Irish Centre for Crop Improvement VICCI

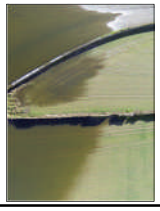
Six Crops

Four Challenges

Nutrient Use Efficiency

Disease Resistance

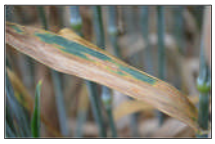
Abiotic Stress Tolerance



Import Replacement

Approaches to crop improvement

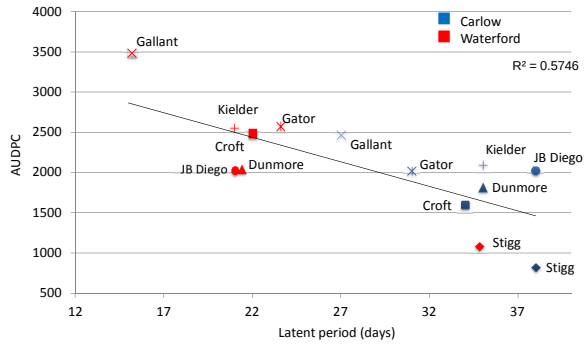
- Phenotyping heritage / novel collections (NIAB, JHI; UK)
- Characterise the genetics that underpins resistance
- Field phenotyping (labour intensive) but continues to 2020



Septoria tritici

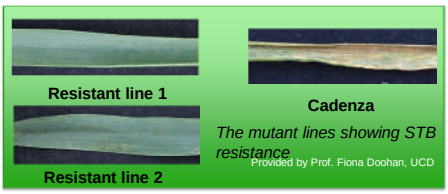
Approaches to crop improvement

- Identification of pre-symptomatic (latent) phase in supporting strong partial resistance against stb disease



Approaches to crop improvement

- Examples of STB – related genes identified:
  - Identified fungal genes (effectors) important for STB disease development
  - Corresponding plant protein receptors, that they interact with – and shown that interactors can enhance STB resistance ('lock and key')
  - Identified cell wall genes in wheat linked with STB resistance
  - Identified wheat lines (non-GM mutants) with STB resistance and provided to breeders (currently identifying the underpinning genes).



The mutant lines showing STB resistance

Provided by Prof. Fiona Doohan, UCD

Approaches to crop improvement

- Genes that enhance FHB resistance and yield (e.g. transcription factor, kinase)
- Others e.g.a Transferase that enhances FHB resistance and co-locates with a yield QTL

By assessing the effect of turning off or 'silencing' a gene on FHB development, we can test If a gene is a good candidate as a disease resistance gene – i.e. does turning off the gene lead to more disease?

Approaches to crop improvement

- Database of disease-specific and/or broad-spectrum candidate disease resistance genes against STB
- Potential use as genetic markers for STB resistance by breeders

- Complete datasets detailing genetic response to FHB disease
- Candidate FHB disease resistance genes
- Development of markers for plant breeding

- Speed Breeding
  6 v. 3 cereal cycles
  4 v. 2 oilseed rape
- Mutation Breeding

Key Activities and Prioritization

- Developing new approaches to crop improvement by sourcing and integrating improved genetics e.g. VICCI
- Innovation for field phenotyping – nanosensors for pre-symptomatic disease diagnostics
- Deploy markers into industry-led programmes
- Systems approach to plant health
- Develop robust cropping systems including rotations, cultivations, targeted nutrients and IPM

Acknowledgements

CIVYL and WheatENHANCE projects

CerealPath

The impact of field headlands on crop performance in Irish tillage fields

Mark Ward [1,2], Dermot Forristal [2] and Kevin Mc Donnell [1]
[1]School of Agriculture and Food Science, University College Dublin
[2]Teagasc Crops Research Centre Oakpark

SUMMARY

Headlands are an integral component of agricultural landscapes, found on the boundaries of all agricultural fields. They can be categorised as 'turning' headlands where machines turn at the end of bouts and 'non-turning' where traffic patterns are similar to the rest of the field. Fields that do not have parallel sides will often have one headland along the length of the field with some machine turning on it.

Past studies, have indicated lower grain yields in crops grown next to field boundaries when compared with the rest of the field. Winter wheat yield penalties greater than 15% have been recorded on UK headlands with similar trends recorded for winter barley, spring barley and sugar beet. Different studies attribute various reasons such as machine-induced soil compaction, shading, water competition and grazing from small mammals as the cause of the yield difference.

There is little information on the impact of headlands on crop performance on Irish fields, where smaller field size coupled with frequently wetter soils may combine to exacerbate the effects. The research reported here is part of an EU project (CTF-OPTIMOVE) funded by DAFM and Teagasc through the ICTAGRI Eranet. A key objective of the project is to determine, by surveying farmers' fields, the impact of field headlands on cereal crop performance. Forty randomly selected grower fields across the main crop producing area of the country were studied with the results from 23 spring barley crops reported here. At each field site, a turning headland was selected and a systematic zone designation was applied based on traffic patterns at the headland. Four zones were designated (A, B, C and D): Zone A is next to the field boundary and is not subject to the most traffic; Zone B is the main headland turning area subject to greatest traffic; Zone C is a transition area between the headland and the in-field area and; Zone D is an in-field area. Crop measurements were taken at four different transects, each crossing four zones, giving four replications.

The crop measurements taken included: plant density (plant counts) post sowing; light interception, which indicates biomass growth, on a couple of occasions during the growing season and; final yield and its components using multiple hand harvested samples. Soil texture analysis was carried out at each site.

Mean spring barley plant densities ranged from 243 plants/m^2 at zone A to 257 at zone D and light interception varied from 75-82% between zones A and D. Higher light interception values indicate denser crops. Spring barley yields ranged from 6.45 t ha^{-1} at zone A to 8.53 t ha^{-1} at zone D with all zones statistically different from each other.

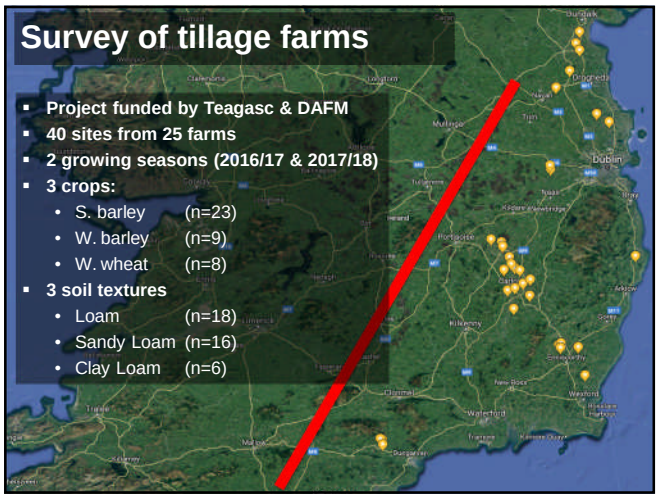
Zone A was the lowest yielding zone at 72% of the sites while zone D was consistently the highest yielding zone. The differences recorded are associated with soil structural effects and variability in input applications.

The impact of field headlands on crop performance in Irish tillage fields

Mark Ward
Teagasc CELUP
Oak Park Crops Research

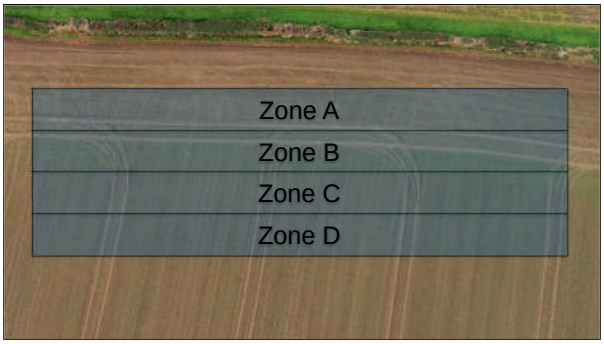
Supervisors: Dermot Forristal (Teagasc)
and Kevin McDonnell (UCD)

Survey of tillage farms



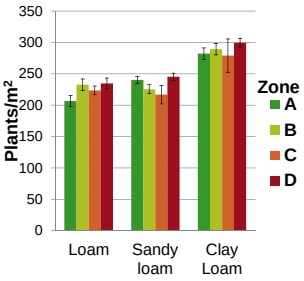
- **Project funded by Teagasc & DAFM**
- **40 sites from 25 farms**
- **2 growing seasons (2016/17 & 2017/18)**
- **3 crops:**
  - S. barley (n=23)
  - W. barley (n=9)
  - W. wheat (n=8)
- **3 soil textures**
  - Loam (n=18)
  - Sandy Loam (n=16)
  - Clay Loam (n=6)

Areas of focus: Headland zones

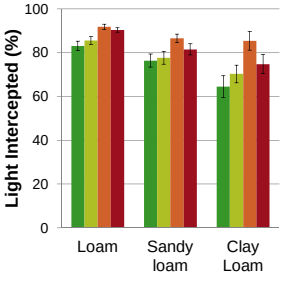


Results: Spring barley

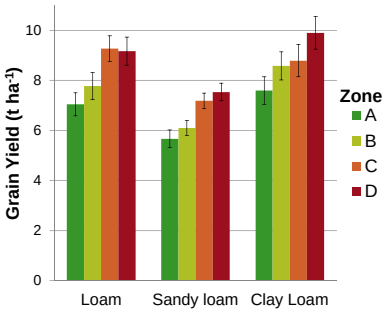
Plant population



Light interception



Spring Barley - Grain yield



- Zones A and B produced the lowest grain yields at 87% of sites
- At 67% of sites - 20% or greater yield reduction from Zone D to Zone A

Conclusions

- Headland position (zone) impacts on all indicators of crop performance
- Zone A was the lowest yielding headland zone
- Zone D was the highest yielding zone
- The differences recorded are associated with soil structural effects and variability in input applications

Machine turning on headland: Impact on traffic paths and soil stress

Brendan Burke and Dermot Forristal
Teagasc CELUP, Oak Park

SUMMARY

On Irish tillage farms field size is relatively small and headlands occupy a greater proportion of the field. Machine weight has increased and turning at field headlands contributes to soil damage. The traffic paths that machines take, while turning, impact on the area of soil that is damaged. There is very little information on the impact of machine size/type and chosen turning method on the area tracked or on the stress imposed on the soil.

In autumn 2017 and spring 2018 a survey of machinery turning operations on headlands was carried out to determine the area tracked by different machine systems, and to estimate the resulting soil stress. Machinery movements on headlands were studied during ploughing, cultivating and sowing operations on 35 farms in the east and south of Ireland.

Five turning patterns were identified and the dimensions of the wheel paths and all parts of the turning operation were measured. Machine specification details, including tyre sizes, were recorded. Analysis using AutoCAD, allowed the area of single and overlapped tracks in a defined headland area to be measured. The impact of the machine's weight on the soil at the field headlands was estimated from axle loads, tyre sizes and inflation pressures, using a soil stress model (Soilflex).

The type of headland turn deployed impacted on the proportion of ground tracked by the load-carrying rear tractor wheels. Attempts to limit the headland width, by practicing a long-loop turn for a trailed implement, or a four-point turn for a mounted implement, resulted in more headland traffic. The 'skip- pass' turn, enabled by auto-steer with high accuracy GPS, resulted in the least amount of headland traffic with less than 35% of the headland area tracked once, compared to 40 to 65% for other turn types. Axle loads varied from 5.8t to 16.05t for the machines monitored, which with the tyres used resulted in soil stresses varying from less than 70kPa to more than 120kPa. This work also validated the use of required inflation pressure (as determined by tyre size and wheel load) as an accurate indicator of soil stress. The importance of matching tyre size to axle load was illustrated by the commonly used 3m mounted cultivation/sowing combination with a 7t axle load, which with narrow tyres fitted resulted in a soil stress of 115kPa, but when fitted with larger capacity (wider) tyres, stress was reduced to 70 kPa. However the real challenges are the very high axle loads imposed by tractors of more than 150 kW when coupled with mounted equipment. Currently these are not fitted with tyres capable of carrying their > 12t axle loads at low soil stress levels.

Machine turning on headland: Impact on traffic paths and soil stress

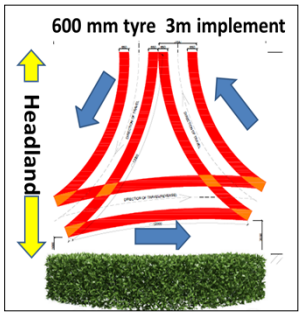
Brendan Burke, Dermot Forristal
Teagasc CELUP
Oak Park Crops Research

Machinery has got heavier – headland turning imposes most loads

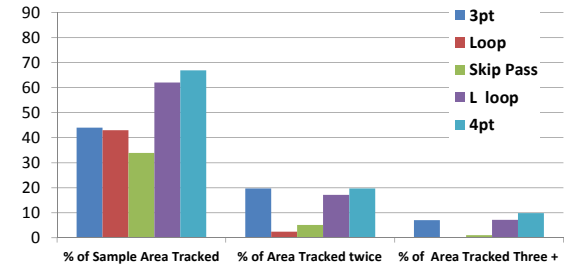
- Machinery headland turning analysed on 35 farms
- CTF Optimove project (D.Forristal and M.Ward)
- Turning pathway dimensions, overlaps and efficiency were recorded.
- Axle loads and tyre details recorded and soil stresses calculated (SOILFLEX stress model)

3 point turn

- Very common with mounted equipment

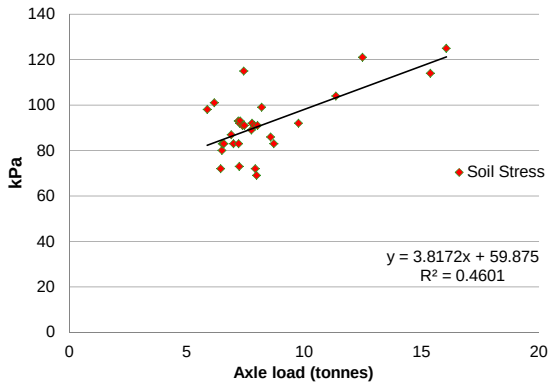


% of Headland tracked (3 Metre implement , 600mm tyre)



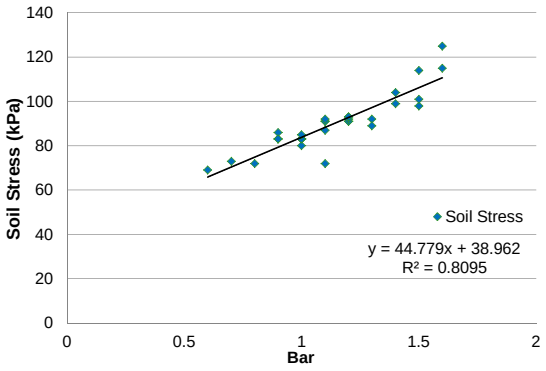
4

Soil stress for axle load



5

Soil stress for recommended tyre pressure



Conclusions

- Machinery weight has increased with axle loads from 5.88 t to 16.05 t recorded in the survey
- 5 headland turn types were identified
- Each impose different levels of headland traffic
- Modern auto steer systems offer scope for reduced headland traffic and more efficient turns
- Required inflation pressure is a good guide to soil stress

Break crop research: An update

Dermot Forristal, Sheila Alves
Teagasc, CELUP, Oak Park

SUMMARY

Irish crop production is characterised by relatively limited use of rotations with just 10% of the crop area planted to non-cereals. Cereal monoculture limits yield potential and potentially creates sustainability difficulties where disease, pest and weed problems can be increased. Cropping rotations can improve profitability and sustainability, but suitable break-crops underpinned by appropriate production technology, and market availability, are essential. A previous Tegasc-led project determined that beans and oilseed rape (OSR) had the most potential as broad-acre break crops for Ireland, but active development is needed to ensure that these crops can be grown profitably, and to ensure that markets and processing capacity would be available. The role of rotations in improving profitability and sustainability needs to be emphasised to growers and their advisors. Traditionally crops were selected on a single year returns basis. Where rotations are used, the impact of break crops must be considered over the entire rotation, including yield benefits to following crops, weed control opportunities etc. At todays prices, rotations that include beans or oilseed rape can increase profit by between 41 and 62% compared to continuous cereals. Even if the protein support is lost, the inclusion of beans in a rotation still increases profit compared to cereal monoculture.

Recent Oak Park research on bean agronomy has underpinned production with seed rate, sowing date and crop nutrition information. The use of alternative crop establishment systems including strip tillage and wide seeding rows for OSR has also been successfully studied. The current break-crop research programme at Oak Park is dominated by the OPTI-BC project in which both beans and OSR are being studied. A key task in this project is a survey monitoring the growth and development of approximately 20 grower's crops of both OSR and beans in each of three seasons. This will identify the range of performance of commercial crops and may indicate the factors, such as region, soil type, rotation position and crop management, which may be associated with that performance. In beans, detailed controlled trials dealing with the impact of cultivation system (plough-based and strip-till) on crop performance and particularly root development, are in place. To date, this work has shown that non-plough and deep seeding systems seem to work well with beans. The 2018 season also showed that sites with heavier textured soil were less severly impacted with the dry conditions; also there is some indication that higher seed rates were slightly less impacted by drought. The aim of the OSR controlled trials is to determine the impact of post–winter crop structure (high biomass vs low biomass vs grazed) on yield potential and to determine the optimum management for different crop structures. Initial results indicate that where advanced crops had simulated grazing damage imposed (cut post winter) they struggled to recover their yield potential when the growing point of the plant was damaged.

Break crop research: An update

Dermot Forristal, Sheila Alves
Teagasc CELUP
Oak Park Crops Research

Break crops research programme

- Why?:
  Limited rotation, few break crops; impact on profit and sustainability
- Which?:
  CROPQUEST identified beans and OSR
- To Date:
  - OSR: Establishment with different cultivation systems
  - BEANS: Basic agronomy (seed rates, sow date, nutrition etc.)
- Current Research:
  - OPTI –BC: Beans and OSR survey and controlled trials
  - Supporting disease and pest work (S.Kildea, L. McNamara)

Rotations, break crops; myths and realities!

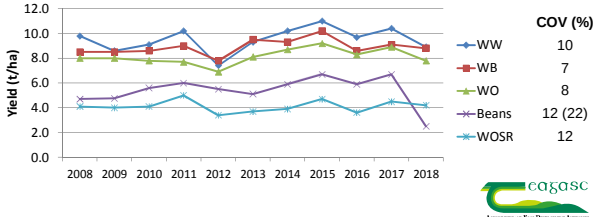
'Break crops are more variable than cereals'

'Break crops must stand on their own two feet'

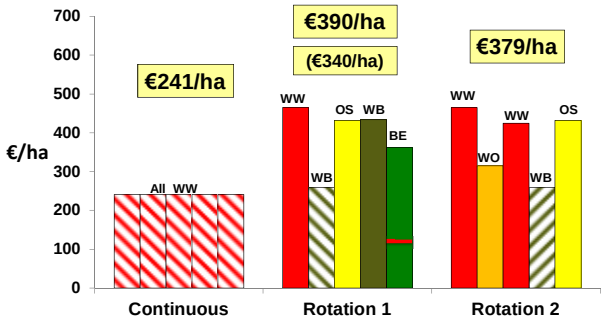
'If break crops are viable, there will be a market'

Not really true.

Cereals and break crops: yield variability over 11 years



Profitable rotations

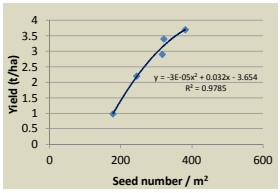


OPTI- BC: Bean programme

Survey of growers crops

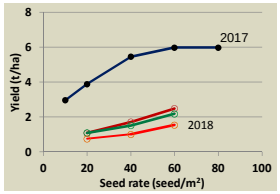
To determine range of performance

- Growth/development measured 3 times
- Detailed management questionnaire



Field trials

- The effect of establishment system and sowing date on bean development, growth and yield
- The effect of differing cultivation systems over winter/spring on root development and soil conditions for plant growth



OPTI- BC: Oilseed rape programme

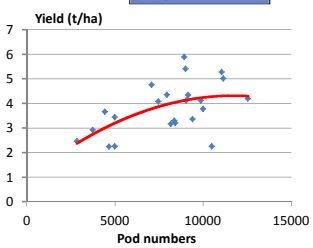
Survey of growers crops

To determine range of performance on farms

- Growth and development measured 4 times
- Detailed management questionnaire

Field trials

- To determine the impact of post winter crop structure on yield potential
- To optimise management for different crop structures
- To evaluate crop structure measurement techniques
- Crop structures***? 'Big'*** *vs.* ***Grazed*** *vs.* ***'Small' crops***



Tools to assess soil structural quality in tillage soils

Giulia Bondi, Jeremy Emmet-Booth, Dermot Forristal,
Teagasc, CELUP, Johnstown Castle and Oak Park

SUMMARY

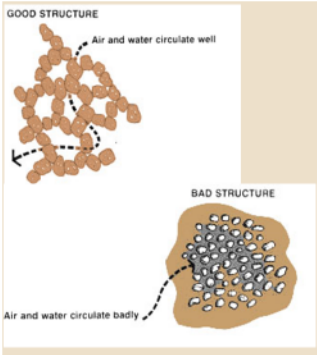
Soil is a vital non-renewable resource which is able to ensure nutrient cycling, viability of food and fibre production, carbon sequestration, water filtration and purification and creation of a suitable habitat for biodiversity. Soil structure is a key factor that supports all these soil functions and it is predominantly influenced by land use and management. The decline in soil structure quality is increasingly seen as a form of soil degradation and is often related to land use and soil/crop management practices. The scientific community often attributes the evaluation of soil structural quality to physical parameters, considered more objective and measurable, such as bulk density or particle size distribution. However, recent research within the field of visual soil assessment has enabled the quick evaluation of soil structure by different land users. Profile and spade methods have been introduced by the scientific community as efficient Visual Soil Evaluation (VSE) techniques for assessing management impact on arable soil structural quality. However, all these approaches have both merits and limitations. The Visual Evaluation of Soil Structure (VESS) is considered a simple method, quick to perform, and designed to be accessible to different users. However, as a shallow spade method, it assesses to 25 cm depth and therefore may not capture signs of compaction occurring below this depth. SubVESS, as a profile method, can capture the presence of transition layers due to management effects to 1 m depth. However, despite giving more detailed information, full profile methods may be costly, time consuming and potentially destructive. This led to the need for a technique that combines elements of VESS and SubVESS methodologies which would provide additional information on soil structural quality in arable soils without requiring extra resources.

Our aims were: (i) to develop a new procedure combining VESS and SubVESS approaches, called the Double Spade method (DS); and (ii) to compare visual methods VESS, SubVESS and DS with quantitative measures in order to assess soil quality on arable headlands and in-field areas. In-field and headland zones at 10 arable sites in Ireland under conventional tillage were surveyed using the methods, assessing to ≈ 25 (VESS), 40 (DS) and 80 (SubVESS) cm depth respectively. Conventional measurements such as soil bulk density were also collected. From the soils surveyed, VESS did not always capture the need for soil management action and did not differentiate between field zones. SubVESS and the DS methods were much more sensitive than either VESS or quantitative bulk density as they differentiated between headlands and in-field measurements. DS gave additional information to VESS indicating damage below 20 cm depth without the need for a full soil pit excavation. It is suggested that SubVESS may be appropriate to further investigate suspected issues as indicated by DS, but not for routine surveys over large areas.

SQUARE:
Tools to assess soil structural quality in tillage soils

Giulia Bondi[1], Jeremy Emmet-Booth[2,3], Dermot Forristal[2]
[1]TEAGASC, CELUP, Johnstown,
[2] TEAGASC Oak Park,
[3]UCD

Soil structure



What is it?
- **Arrangement of soil particles and pore spaces between them**

Why is it important?
- **Regulates biological, chemical and physical properties**

Why Concern?
- **Management (Cultivation, heavy machines)can damage soil structure**
- **Compaction!!**

Why and how to assess soil structure?

Why?.....Management may need to be changed

How?.....
- Bulk density (and calculated porosity)
- Strength measurements (e.g. penetrometer)
- Visual examination and scoring

Visual Soil Examination and Evaluation (VSEE) techniques:
- **Spade methods: Hand dug to 25cm Easily done**
- **Profile methods: Digger to 100cm Very disruptive**

Visual methods limitation on tillage soils:
- Spade methods do not capture 'transition' layer
- Below cultivation (20 to 40 cm) is key.
- **SQUARE:**
  Proposed a deep in- situ Spade method
  Double Spade (DS) to 40cm

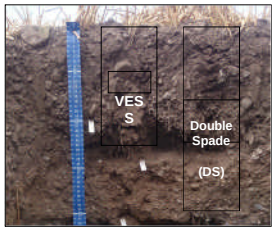
SQUARE- Arable soils survey

Objectives:

- Compare Visual methods VESS, SubVESS (profile) and DS with quantitative measures
- Assess soil quality on Arable headlands and in-field

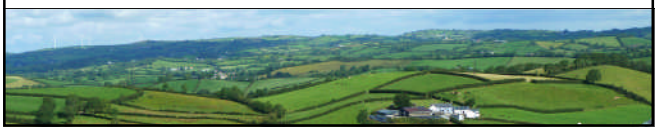
10 tillage sites tested
(in-field vs headland areas)

- VESS – 25 cm depth
- SubVESS – 1 m depth
- **Double Spade (DS) – 40 cm depth**



Structure in-field vs. headland (10 sites)

Measurement	In- Field	Headland	Significance
VESS (score)	2.6	3.0	NS
Sub-Vess (score)	2.7	2.9	*
DS (score)	2.2	2.8	**
DS 0-20 (score)	1.9	2.5	*
DS 20-40 (score)	**2.6**	**3.0**	**
Bulk Density 10-20 ($g\ cm^{-3}$)	1.2	1.3	*
Bulk Density 25-30 ($g\ cm^{-3}$)	1.3	1.4	NS
Bulk Density 35-40 ($g\ cm^{-3}$)	1.4	1.4	NS



What we learned……

- **VESS**
  - Did not differentiate between headland and In-field.
  - Only measures to 20 – 25cm so within ploughed layer
- **SubVESS**
  - Did differentiate between headland and in-field
  - Comprehensive but disruptive (digger needed) limiting numbers
- **Bulk Density**
  - Did not differentiate differences below 20cm
  - Requires lots of samples and not that sensitive
- **Double Spade**
  - Did differentiate between headland and in-field
  - Measured difference in 20-40cm layer
  - Best resolution

VSE techniques are robust and useful for soil structural quality assessment and soil management

Grass weed control: Utilising all the tools

Michael Hennessy
Teagasc, CELUP, Oak Park

SUMMARY

Grass weed control has become more problematic in Ireland due to the increase in non-plough establishment systems, reducing herbicide weed control options, new grass weed populations, and increased herbicide resistance in grass weed populations.The experience of the UK tillage sector in the past 20 years shows us how grass weed control failures have increased and are now a significant cost to the industry. UK farmers are now looking beyond herbicides to a wide variety of cultural control measures.

Reaching for a herbicide to control grass weeds is convenient but if similar herbicides are used continuously over a period of time this will lead to more problematic weed populations for the farmer down the road. All control options available to the farmer should be utilised to avoid build-up of problematic weed populations and herbicide resistance issues.

Cultural control options include; rotation, clean seed, hand rogueing, management of crop margins, herbicides, machinery cleanliness, stubble cultivations, establishment system, time of planting, etc. However before a farmer or advisor can consider what option, or number of options should be used, the type of weed must be considered. Not all options outlined are appropriate control measure for all weeds, with some options being ineffective and the timing of other options determining their success.

Correct identification of the grass weed is paramount to controlling any grass weed problem. There are many recent examples where misidentification has led to incorrect weed control measures and subsequently to an explosion of grass weeds on the farm.

A new project called ‘Enable Conservation Tillage’, which is a European Innovation Partnership project, brings together farmer groups, researchers, advisors, seed industry and ag-chem companies to look at grass weed control in different establishment systems. Grass weeds are one of the main reasons farmers have been reluctant to convert, or stay with, conservation tillage systems.

The project will look at; the effect of control measures in different crop establishment systems, cover crops as a weed control measure, herbicide resistance levels in national weed populations, the usefulness of drone/aerial assessment, novel weed control measures and resistant population. The project will utilise a network of 10 farms across the country as a platform to upskill farmers and industry on weed identification and control measures on these farms.

The aim of the project is to connect with as many people as possible in the tillage industry over the coming five years with the ultimate aim to sustainably control grass weeds and to reduce the risks of grass weeds being a limiting factor to farms converting to conservation tillage systems.

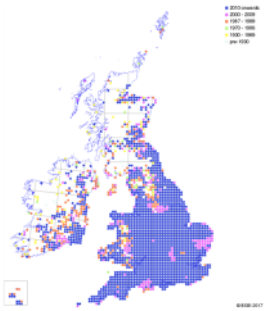
Grass weed control: Utilising all the tools

Michael Hennessy
Teagasc CELUP
Oak Park

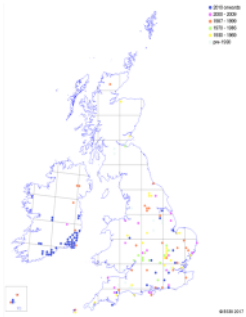
Enable conservation tillage project

- Why?
  - Increasing grass weed problems in plough and other systems
  - Herbicide resistance problems
  - Grass weeds seen as a barrier to the adoption of conservation agriculture techniques
  - Project designed with farmers & industry
    - Focus on farm rather then plot scale
    - Needs practical solutions for different establishment systems and weeds

Grass weed prevalence

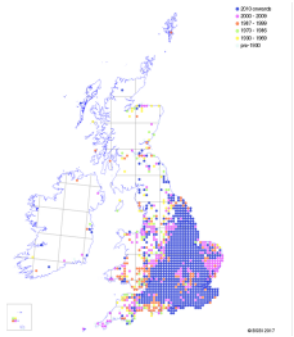


Sterile brome



Canary Grass

Grass weed prevalence



Blackgrass

Irish situation

- More widespread than we would like
- Resistance in populations
- Identification and control vital!!

Control measures

- Simple to intensive

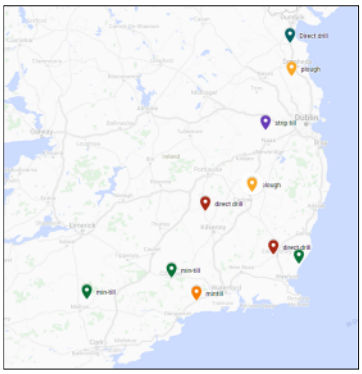
Where to start?

- Correct identification of the problem
  - Different brome species require different control strategies
- Understand the weed biology/ spread potential
  - Do I have a resistant population?
- Identify appropriate control measures for the farm
  - Which are the most effective (for least effort)?
  - How many years should the control measures be implemented?

ECT project

- Aims
  - to educate industry on grass weeds
  - identification, population mapping, control, etc.
- 10 farms identified around the country as platforms for KT and Research
  - Dedicated advisor, researcher and technician

ECT “Focus Farms”



Type	No
Plough	2
Mintill	4
Strip till	3
Zero till	1

Weeds
Wild oats,
Canary Grass,
Bromes,
Blackgrass,
Italian Rye grass

Your involvement

- Workshops on all farms
  - Groups (Farmers, advisors, technical representatives)
- Collecting weed samples (seeds)
  - Herbicide resistance testing
- Project Advisor
  - Jimmy Staples 087 7907758

Herbicide resistance in wild oats: What have we learned?

Rónan Byrne
Teagasc, CELUP, Oak Park

SUMMARY

Herbicide resistance poses problems for crop protection throughout the world, and Ireland is no different. Populations of weeds respond to the selection pressure imposed upon them by herbicides by developing resistance, allowing them to survive herbicide application and reproduce. In Ireland, wild oats are a grass weed, particularly where spring-sown crops are grown regularly. Research carried out in Teagasc Oak Park is only beginning to determine the prevalence of resistance in wild oats. Resistance testing of wild oats taken from fields where weed control was an issue in 2016 uncovered the first resistant Irish wild oats. A number of these populations were found in Co. Wexford, so the decision was made to sample throughout the county during the 2017 growing season. Resistance testing of a panel of these randomly sampled wild oats determined that more than half (~55%) were resistant to at least one herbicide active ingredient. While these results may not be replicated in other regions, they still present a compelling case that herbicide resistance in wild oats may be more prevalent than was initially expected. But what is the cause of this resistance?

Herbicide resistance can be loosely divided into two groups, target site resistance (TSR) and non-target site resistance (NTSR). TSR is where mutation(s) to the herbicide target in the plant stop the herbicide from binding effectively, allowing the plant to survive and reproduce. NTSR may occur when plants gain an increased ability to detoxify, or metabolize herbicides to a concentration where they are no longer lethal to the plant. NTSR poses a significant risk to weed control because it may confer resistance to herbicides that aren't even used on a population of weeds, including herbicides that have not yet been developed. There is mounting evidence that non-target site resistance has a major role in plant resistance to ACCase inhibiting herbicides worldwide. Worryingly, Teagasc research has shown that some Irish wild oats are indeed carrying both target-site and non target-site herbicide resistance traits.

Herbicide resistance in wild oats: What have we learned?

Rónan Byrne
Teagasc CELUP
Oak Park Crops Research

What is herbicide resistance?

- The *evolved* ability of a plant to survive a herbicide dose that would normally kill it.
- How much is out there?
- What is causing it?
- What is *causing* it?
- Where do we go from here?

How much resistance is out there?

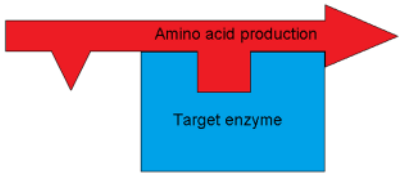
- Initial survey looked at “problem” fields.
- Resistant populations in Wexford.
- Randomly sampled there in 2017.
- Tested a subset for resistance to pinoxaden (Axial) and fenoxaprop (Foxtrot)
- ~ 55% of samples were resistant to at least one herbicide a.i.

How much resistance is out there?

- ~ 55% of samples were resistant to at least one herbicide a.i.

What is causing resistance?

- Two main mechanisms: target site resistance and non-target site resistance.
- Target site resistance: A simple mutation stops the herbicide from binding.
- Usually quite specific.



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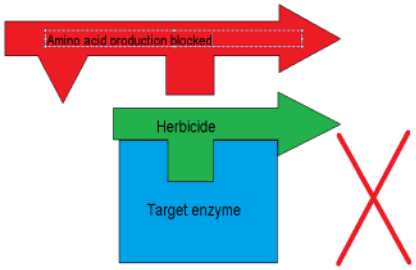
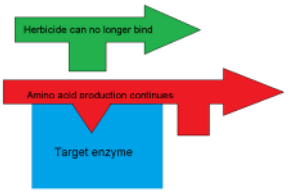


What is causing resistance?

- Two main mechanisms: target site resistance and non-target site resistance.
- Target site resistance: A simple mutation stops the herbicide from binding.
- Usually quite specific.
- Research carried out in Oak Park shows that some Irish wild oats are carrying target site mutations.



Population	Mutation	Substitution	Frequency
Af11	I1781V	ATA->GTA/GTG	21/29
Af13	None	-	-
Af18	D2078G	GAT->GGT	35/36
	I1781V	ATA->GTA/GTG	6/36
	W1999L	TGG->(L)TTG/CTG	3/36
	W2027G	TGG->GGG	2/36
Af24	W2027C	TGG->TGC	12/12

Data courtesy of Paula Byrne, UCD

Non-target resistance?

- Glasshouse studies completed at Oak Park have identified populations of wild oats with non-target site resistance
- Some populations carry both target and non-target site profiles

But really, what is *causing* resistance?

- Mis-use of herbicides i.e. using the herbicide year after year?
- Lack of crop rotation?
- Using reduced rates of herbicides?
- Lack of IPM approach?

Thanks

- My supervisors: Susanne Barth and John Spink
- Advisors, growers and agronomists who helped acquire samples
- ECT project
- Everyone in Oak Park
- Funding partners: ISTA

Oats research – Update

John Finnan
Teagasc, CELUP, Oak Park

SUMMARY

Oats have been grown in Ireland since the bronze age when the first farmers started farming. The crop is well adapted to moist temperate conditions and was once grown throughout the country as an important feed for horses and ruminants but also for humans as oatmeal was once a substantial part of our diet and oat mills were once prolific throughout the country. The acerage of the crop has declined considerably since the middle of the 19th century when the crop was grown on 670000 ha, primarily as a result of the replacement of horses by vehicles. However, oats still represent an important part of the cereal industry. For growers, oats offer a take-all break as well as an alternative to wheat and barley. The oat industry produces a range of products for equine and human markets. Appreciation has grown of the nutritional and health benefits of oats which has led to the development of high value markets for oats. The growth of the Irish oat industry is important as the production of Irish produced oats for distinctive Irish oat products reduces the dependency of growers on commodity markets. Teagasc has an extensive agronomy programme whose objective is to support oat growers and the oat industry. Research encompasses both autumn and spring sown crops and covers a range of important issues including seeding rates, crop nutrition, disease control, lodging and grain quality. Once complete, the results of this research will be published as a comprehensive oat growers guide.

A significant part of the oat research programme has concentrated on spring sown crops. Grain yields of spring sown crops increase in response to added nitrogen and typically reach a maximum at 150 kg N/ha for a variety such as Husky grown on Index 1 soils. Although the yield potential of spring sown crops is lower than that of autumn sown crops, the response to nitrogen of spring sown crops is very similar to that of autumn sown crops. The timing of nitrogen supply does not have a large impact on the yield of spring oat crops as long as the nitrogen requirements of the crop have been applied by GS30. Similarly, different strategies for splitting nitrogen between emergence and GS30 tend to have only small effects on yield. For spring sown crops, hectolitre weight tends to fall as the rate of nitrogen is increased and with delayed application of nitrogen, this was also observed for autumn sown crops. However, these trends were much stronger in autumn sown crops than in spring sown crops.

Oats research - Update

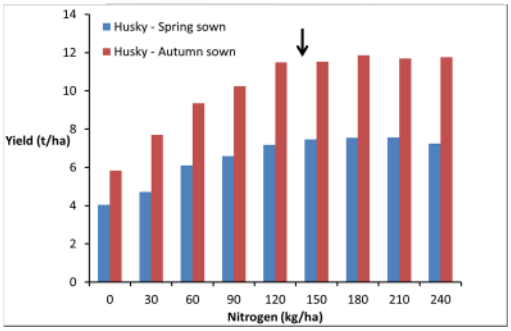
John Finnan

Teagasc CELUP
Oak Park Crops Research

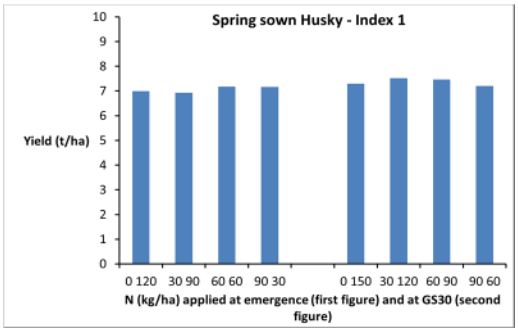
Oats – and their value

- **Oat crop:** take-all break; alternative to wheat and barley
- **Oat industry:** Irish oat products -separate oats from commodity markets
- **Teagasc research:** seed rates, nutrition, disease, lodging, grain quality

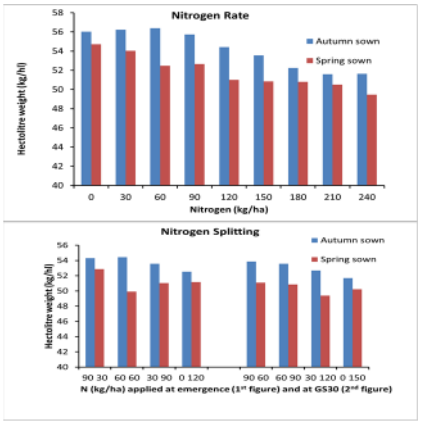
Nitrogen for spring oats



Nitrogen splitting



Hectolitre weight



- Decrease with N rate and with late application of N
- Weaker trends than for autumn sown oats

Conclusions

- Optimal N rate for spring oats (Index 1) 120-150 kg/ha
- N splitting strategy will not affect yield as long as N has been applied by GS30
- Hectolitre weight falls with increasing N rate and with delayed application

IPM assessment in temperate arable farming (Ireland and the U.K.)

Stephen Kildea
Teagasc, CELUP, Oak Park

SUMMARY

In recent years the concept of integrated pest management (IPM) has been increasingly promoted as a key component of sustainable cropping production systems. This emphasis on IPM has resulted from the need to provide alternative pest control strategies to offset potential reductions in the availability of plant protection products, which are likely to occur through regulatory restrictions or resistance development. In addition, all EU member states are required under the Sustainable Use Directive (2009/128/EC) to implement a National Action Plan (NAP), in which the promotion of IPM practices must be included. If IPM is to be enhanced in arable cropping systems it is first essential to accurately capture levels of IPM currently practised and potential means through which practises can be changed to improve uptake.

Simply put, IPM can be regarded as a means to control pests (any biotic stress such as diseases, pests and weeds, that negatively impacts crop productivity) in an economically and environmentally sustainable manner. In doing so it must be inclusive of all practises through the various stages of production, with multiple measures implemented and combining to have the desired effect. Such systems based approaches undoubtedly are difficult to assess. To overcome these difficulties a survey consisting of 14 questions, including those gauging IPM uptake, IPM perception and a further 8 relating to the farmer and farm were developed. These were posed to a sample of farmers in Ireland and the U.K., through the National Farm Survey and equivalent. To capture levels of IPM uptake with the responses stakeholders (farmers, agronomist, merchants, regulators and researchers) were engaged and a consensus on how different responses relate to IPM agreed upon. Encouragingly, there was general agreement between the different stakeholders, irrespective of their occupation or country of origin on how the value of potential responses to IPM uptake.

By applying the metric established through the stakeholder consultation to the responses from the survey it has been possible to provide an overview of levels of IPM practised on Irish and U.K. arable farms. Whilst a large range in the levels of IPM uptake was observed amongst the farms surveyed, all were practising some level of IPM with none scoring <20 marks out of 100. However the variation in responses clearly shows that differences exist and further research is required to both identify why these differences occur, but equally how they can be improved. Initial analysis of responses suggests levels of familiarity of IPM is a key driver in uptake of IPM practises on farm, with those more familiar more likely to practise higher levels of IPM.

IPM assessment in temperate arable farming (IE and UK)

EPIC IPM

Steven Kildea
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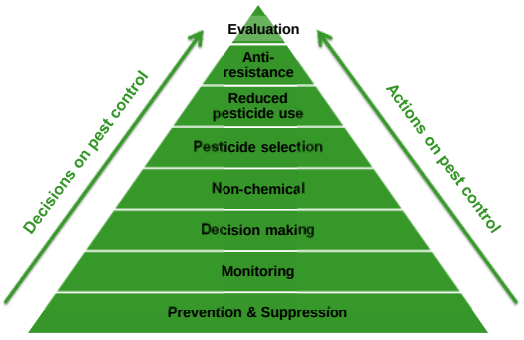
Literature review

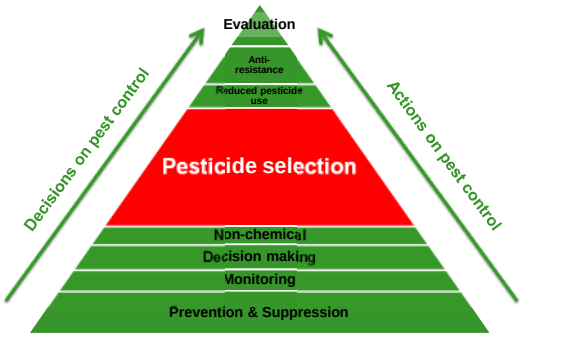
"Integrated pest management (IPM) means **careful consideration of all available plant protection methods and sub-sequent integration of appropriate measures** that discourage the development of populations of harmful organisms (including weeds, diseases, insect and other animal pests), and keep the use of plant protection products and other forms of **intervention to levels that are economically and ecologically justified, and reduce or minimise risks to human health and the environment**. IPM emphasises the growth of a healthy crop with the least possible disruption to agroecosystems and encourages natural (non-chemical) pest control mechanisms"

(The Sustainable Use Directive 2009/128/ EC).

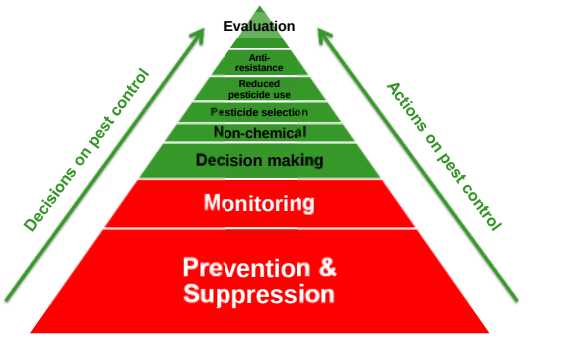
It is a process of decisions & actions



Currently?



Need to reset the pyramid



Why IPM in arable cropping?

- Loss of important actives expected in near future
  - Regulatory pressures
  - Increased development of resistance
- New actives (fungicides) are on the horizon
  - Resistance management will be essential
  - Reduced tools to achieve this??
- **Must increase attention and adoption of IPM practices across all arable systems - collective approach needed!**

Optimising agronomic practises (IPM)

Combining agronomy, variety and chemistry to maintain control of septoria tritici in wheat

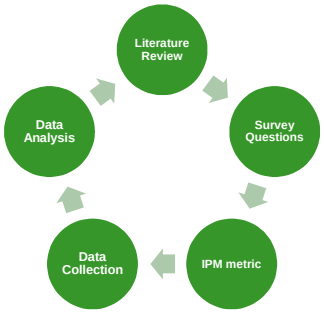
- Three varieties with different Septoria susceptibility
- Two sowing dates
- Two seeding rates
- Four fungicide treatments:
- What crop should I grow?
- Where to grow?

One Pest - need to do for all pests!

IPM in Irish arable sector?

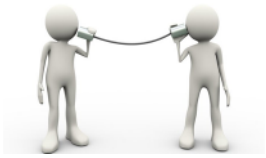
- **What do we know? What do we think we know? What do we need to know?**
  - Very little information on adoption and even less on perception
  - How familiar are Irish arable farmers with the concept of IPM?
- **Why do "we" need to know more?**
  - Establish baselines
  - Identify barriers to uptake
  - Find solutions to improve perception and increase uptake
  - Clear need to increase IPM at farm level
- **How do we go about gathering such information?**
  - Direct line to growers
  - Survey (questionnaire)

Accurately capturing IPM on arable farms



Growers Survey

- Ireland, N. Ireland, England & Scotland
- Collect c. 50 responses/country
- Sample must be representative of the arable farming population
- 14 IPM Q's + 8 sociodemographic Q's
- c.10 mins to complete



Best Arable Practise Survey

IPM Practise	IPM Perception	The what, where and why?
9 Questions	**5 Questions**	**8 Questions**
Q: Proportion of farm in continuous cereals..	**Q:** How familiar are you with IPM..	**Q**: What is your position on the farm..
Q: What influences your choice of cereal variety..	**Q:** Which of the following do you regard as IPM..	**Q:** How much farm do you manage..
Q: What preventative measures used for control…	**Q:** What factors influence your decision to adjust..	**Q:** What qualifications have you achieved..

Sample Questions: Practise

Which preventative measures do <u>you</u> currently employ to control the introduction and spread of pests on <u>your farm?</u> *Please tick all the boxes below that apply.*

a) *<u>To control weeds</u>*

- ☐ Stale seedbeds
- ☐ Full inversion ploughing to control low dormancy weeds
- ☐ Min-till to control high dormancy weeds
- ☐ Pre-emergence herbicide applications
- ☐ Spot spraying weeds (if necessary)
- ☐ Hand rogueing/hoeing weeds
- ☐ Manage headlands differently to remainder of field
- ☐ Fields with high weed levels are harvested last
- ☐ Crop inspections, please indicate frequency; once or twice per *(please circle one of the following options):*

week	month	season

Collecting the data

- On farm recorders
  - NI: pesticide usage survey
  - ROI: national farm survey
- Postal/email
  - England: farm business survey
  - Scotland: pesticide usage survey
- Other
  - ROI: Discussion groups/farmer meetings

Country	Responses
England	53
Ireland	58
N. Ireland	71
Scotland	43
Ireland	189

Creating a metric to evaluate responses

- How to quantify adoption of IPM?
- "Face to face workshop" followed by "email workshop"
  - Advisors
  - Farmers
  - Researchers
  - Merchants
  - Policy makers
- 6 key questions relating to adoption of IPM
- Collectively rate individual options for each Q (1-5 scale)
- Decide on % contribution of Q to overall IPM score

Consensus amongst stakeholders?

Question	Differences
Q: Proportion of land in continuous cereals?	No Differences
Q: Why you use an arable rotation?	No Differences
Q: What influences variety choice?	**Farmers/Agronomists rate higher**
Q: Preventive measures are used to control pests?	No Differences
Q: Factors considered in pest management plan?	No Differences
Q: Membership of discussion group?	**Farmers/Agronomists rate higher**

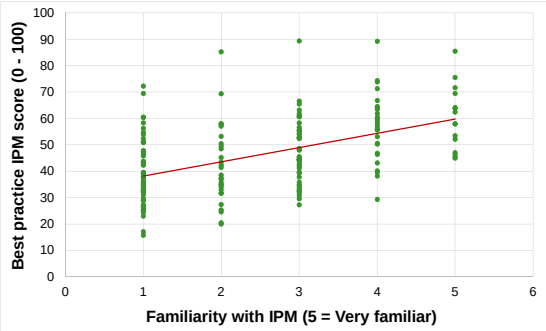
Both questions contribute lowest amount to final score

Conclusions & Questions

- Combination of 6 questions and metric allows a simple means of measuring IPM on arable farms
- Combining with questions on perception & farm enterprise information will aid identification of potential means to improve IPM
- Can we determine what an acceptable level of IPM is?
- Does IPM relate to profitability of the enterprise?
- Can we identify why differences in IPM levels may occur?

Preliminary findings

Positive relationship between practise and familiarity of IPM

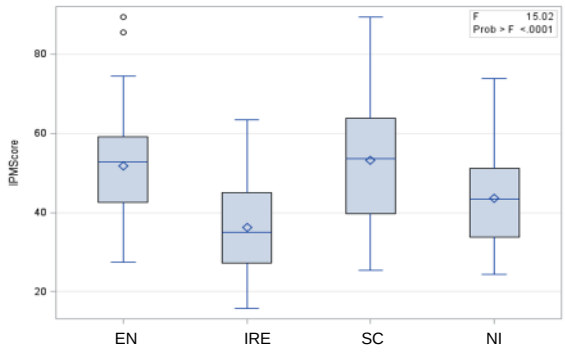


Spearman Correlation Coefficient=0.49521, P<0.0001

Impact of information source on familiarity

Information source	Relationship to familiarity
Farmer discussion groups	++
Open days / crop walks	++
Independent agronomist	+
Chemical company rep	ns
Contractors	ns
Farming press	ns
Other farmers	-
Past experience	-
Merchant agronomist	- -

Differences exist between countries



Future prospects

Need to increase familiarity of IPM

What is IPM?

"Integrated pest management (IPM) means careful consideration of all available plant protection methods and sub-sequent integration of appropriate measures that discourage the development of populations of harmful organisms (including weeds, diseases, insect and other animal pests), and keep the use of plant protection products and other forms of intervention to levels that are economically and ecologically justified, and reduce or minimise risks to human health and the environment. IPM emphasises the growth of a healthy crop with the least possible disruption to agroecosystems and encourages natural (non-chemical) pest control mechanisms"

OR

Best arable practise

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Notes: