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Agriculture and Food Development Authority

IRISH FARMERS JOURNAL farmersjournal.ie

CROPS & SPREADERS

Teagasc Oak Park
Open Day 2019

www.teagasc.ie

Foreword

Teagasc Oak Park 'Crops and Spreaders' Open Day, 2019
Welcome to the Teagasc Oak Park crops Open Day, which provides an excellent opportunity for you to witness first-hand our applied and strategic research programme. Today, Oak Park researchers and Teagasc colleagues from our environment and advisory programmes are pleased to demonstrate the latest innovations and optimum management strategies across crops including; spring and winter barley, winter wheat, oats, beans, oilseed rape & rye. The focus includes pest and disease control strategies, IPM, efficient nutrient management, precise agronomy practises, plus advanced genetic strategies to enhance stress tolerance. The latest varieties will also be demonstrated by the DAFM variety testing team.

With our partner, the Farmers Journal this year's Open Day has a focus on the importance of accurate fertiliser calibration and spreading in support of sustainable productivity, with live spreader demonstrations through the day. In addition, there will be many other areas of relevance to tillage farmers and the farming industry in general, including:

- Field margin management and enhancement of natural pest predators, to try and minimise the impact of losing insecticide products
- Farm safety highlighting the dangers of operating machinery and handling large fertiliser loads
- The importance of biodiversity as a means to maintain bee populations
- A technology village which will highlight the work being done through the application of advanced genetic approaches to improve crop performance and resilience
- The importance of soil health and quality to support crop productivity

In the centre of this booklet you will find a map of the campus detailing the suggested route across the 24 stands containing over 100 demonstration boards. This route enables you to pick out areas of interest so you can start and stop your tour wherever you wish.

Hosting the Open Day requires significant work and planning and I wish to thank all Oak Park staff for their commitment and effort in preparing the site, boards and facilities across the campus. In addition, I wish to acknowledge the Teagasc tillage stakeholder group for their support and input to ensure the relevance of our research programme to the industry at large.

Our priority for this Crops and Spreaders day is to maximise engagement and research demonstration with attendees and I hope your day here in Oak Park is both enjoyable and productive in supporting your business interests.

Dr. Ewen Mullins
Head of Crops Research
Teagasc, Oak Park

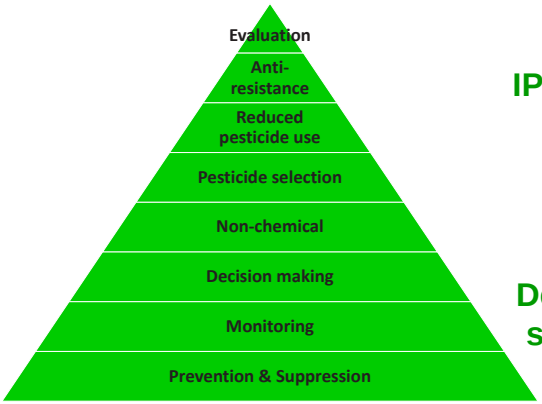
Integrated Pest Management

What is IPM?

The utilisation of all available control measures to reduce impacts of pests on cropping systems

Why use IPM?

Increasing need to manage effective pest control resources in sustainable manner



Guiding principals of IPM

IPM is a knowledge based process

Decisions taken to reflect specific crop conditions

EPIC IPM

Notes:

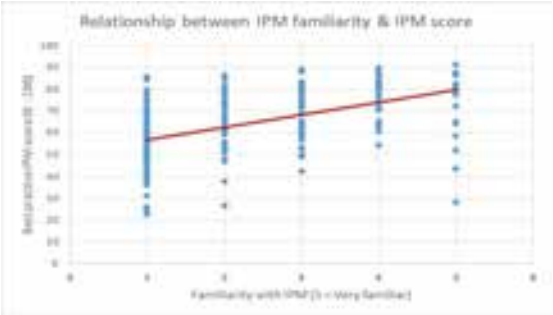
Increasing IPM on arable farms

Set of 6 questions designed to gauge levels of IPM on arable farms

What level of IPM do you practise?
Proportion of land in continuous cereals?
Why you use an arable rotation?
What influences variety choice?
Preventive measures are used to control pests?
Factors considered in pest management plan?
Membership of discussion group?

Factors influencing IPM

- **Familiarity with IPM**
- **Relationship with advisor**
- **Information sources**



EPIC IPM

Notes:

Leatherjacket survey

Background

Leatherjacket pests cost up to £1.5 million worth of damage in Northern Ireland each year. Chlorpyrifos was banned in 2016, and since then there have been no effective control methods available to farmers

Damage Caused

Project Aims

- Identify the common species of cranefly in Ireland
- Analyze microbiome from areas of low and high infestation rates
- Asses any biocontrol options found

Interested in taking part?

Please leave your contact details with me!

Or email aisling.moffat@teagasc.ie

Sampling Involves:
Grassland: 25 soil cores per field
Tillage: 20x 30 cm row scratches

Notes:

BYDV control

Barley yellow Dwarfing Virus is spread by Aphids

Risk Factors:

- Early sown autumn crops / late sown spring crops
- Mild winters (Aphids overwintering)
- Mild Autumns (Aphid migration period lengthened)

Autumn cereals		
Sowing date	BYDV Risk	Control Action
Early sown (Sept)	High	Aphicide at 2/3 leaf stage & Early Nov
Oct sown	Medium to high	Pyrethroid aphicide Early Nov
Emerging after Nov	Low	Control needed in mild winters where aphids are plentiful or in risk areas

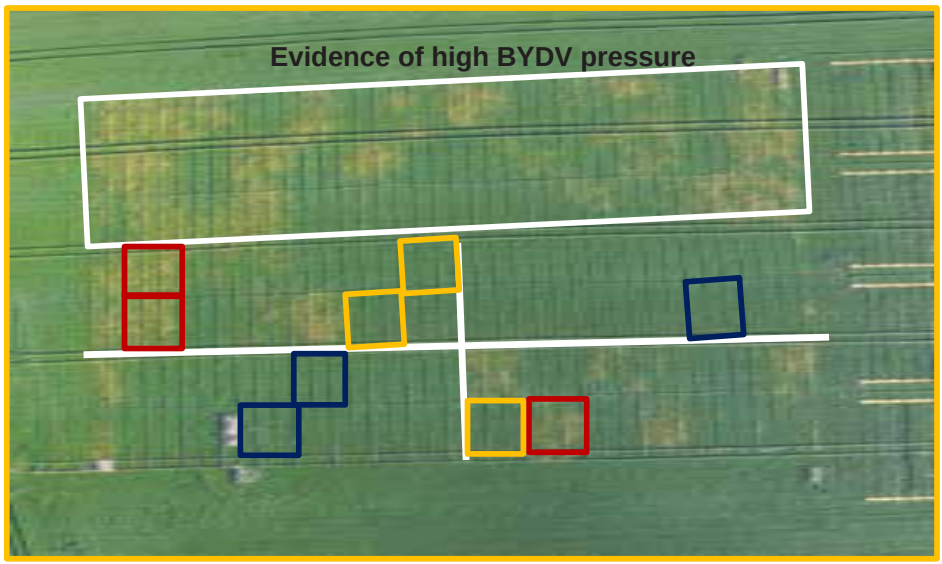
Where crops did not receive their insecticide in Nov, they may still benefit from a treatment in Dec-Feb (pre- GS31)

Spring cereals		
Sowing date	BYDV Risk	Control Action
March sown	Low	Aphicide spray may not be necessary
April sown	Medium to high	Pyrethroid aphicide at 4 leaf

Notes:

BYDV control

Winter barley, Cassia sown 12th October, Cork



Untreated **Pyrethroid** **Seed Treatment**

Notes:

'Knock Down Resistance'

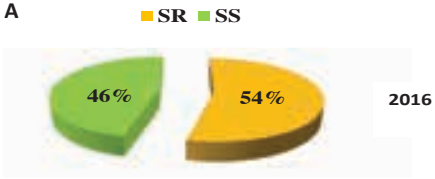
'Knock Down Resistance' or 'KDR' was first identified in Ireland 2013

- Aphids with '*kdr*' gene are less susceptible to pyrethroids
- To date, '*kdr*' has only been identified in *Sitobion avenae* (Grain Aphid), an important vector of Barley Yellow Dwarfing Virus (BYDV)
- A single clone of *Sitobion avenae*, SA3 is most commonly associated with pyrethroid resistance
- Research indicates aphids carrying the resistance gene occur in all major grain growing regions
- When exposed to full rate applications of pyrethroids, approx. 40-50% of *Sitobion avenae* with the resistance gene will survive to at least 12 days post exposure
- Individual aphids exposed to full rate applications of pyrethroids continue to produce new nymphs post insecticide exposure

Notes:

'Knock Down Resistance'

A



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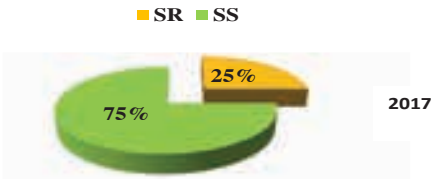

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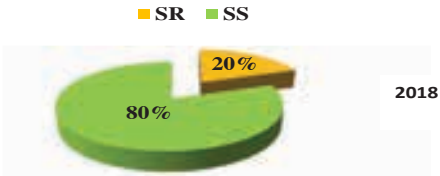


- Stratified random sampling for aphids was carried out at 621 points across 89 cereal fields to collect *S. avenae*
- The incidence of heterozygous resistant (SR) and non-resistant, pyrethroid susceptible (SS) aphids was recorded from three years of sampling in Irish cereal fields, 2016 (A), 2017 (B), 2018 (C)
- All aphids scored as heterozygous for the kdr mutation, and no homozygotes (kdr-RR) genotypes were detected

EPIC IPM

Notes:

‘BYDV control post Neonics’

2018 was the last season neonicotinoid seed treatment could be used to control BYDV in winter cereals

- Limited in our control options to manage aphids.
- Only one chemistry (pyrethroids) for BYDV control in winter and spring barley
- This may increase resistance risk.
- Integrated Pest Management increasingly important

Pre-planning IPM:
- Cultural control; i.e. drilling date
- Minimize “green bridge”
- Variety selection

In season IPM:
- Improved monitoring/forecasting
- Targeted application of insecticides
- Establishing thresholds
- Anti-resistance strategies: Monitoring for control failure, Alternative insecticides
- Biocontrol: Encouraging natural enemies

Notes:

Biodiversity and bees

Irish Bee species

Honeybee (1)

Solitary bees (77)

Bumblebees (20)

Why are bees important?

- **Pollination of food crops:** oilseed rape, peas, beans, apples, soft fruit
- **Pollination of wildflowers, trees**
- **Sustainability of Irish agriculture and food**
- **Production of honey**

Why bees are declining?

- **Less wildflowers in the countryside :** Pollen provides protein and nectar provides carbohydrate.
- **Lack of continuity of flowers:** Bees need food all year round - a diversity of flowering plants in the landscape.
- **Less nesting sites**

Bees need flowers

- *in hedgerows*
- *in field margins*
- *in roadside margins*
- *anywhere!*

✓ *Allow hedgerows to flower*
✓ *Don't spray field margins*

	Native trees / shrubs	Climbers	Wildflowers
January	Willow		Primrose
	Hazel		Bluebell
	Blackthorn		Dandelion
	Holly	Dog rose	Clover
	Crab apple	Honeysuckle	Vetches
	Whitethorn	Blackberry	Knapweed
December	Gorse/furze /whins	Ivy	Heather





Notes:

Honeybees and pollination

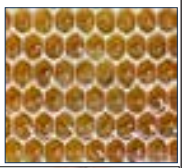
Social insects:

- Live and work in a group (colony)
- Recognise each member of the colony
- Colony size = 40 000 workers
- Perennial nest

Why honeybees are important pollinators?

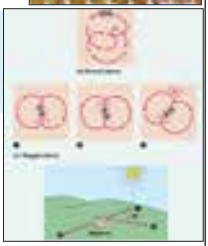
Honeybees need pollen and nastar for food…

- Pollen…source protein
- Nectar…source carbohydrate

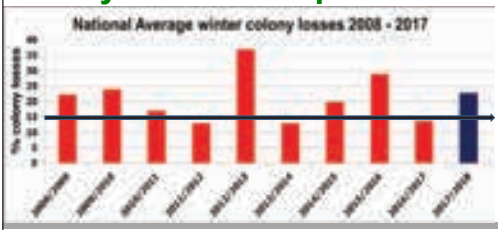


Why bees are efficient pollinators?

- Branched hairs
- Flower constancy
- Special communication between members…



Colony losses and potential reasons….



- The Varroa mite
- Lack of forage/diversity of forage
- Inadvertent chemical applications

Lead researcher of the National Apiculture Programme:
Mary.Frances.Coffey@ul.ie

Notes:

Ecological Focus Areas

Potential Benefits of EFAs

For the Farmer



- Enhanced crop pest control (natural predators)
- Increased pollination
- Decreased soil erosion
- Prevention of soil nutrient leaching

For Biodiversity



- Increased species diversity
- Increased habitat and landscape diversity
- Maintenance of 'wildlife corridors'

Social & Tourism



- Public goods (Ecosystem Products and Services)
- Maintenance of historical features and heritage
- Clean, green image

Some Current and Potential EFAs

Fig 1: Hedgerows are currently eligible as EFAs in Ireland

Fig 2: Drains are currently eligible as EFAs in Ireland

Fig 3: Buffer strips are currently eligible as EFAs in Ireland

Fig 4: Fallow land is currently eligible as EFAs in Ireland

Fig 5: Field Margins are eligible as EFAs under EU prescriptions but are currently not eligible under Irish regulations

Robyn.Earl@teagasc.ie

Notes:

Natural enemies of aphids for IPM

Sitobion avenae- grain aphid spreads BYDV, feeds on grain heads and can become resistant to pesticides

Wildlife habitats such as field margins support a variety of predators of aphids

- **Hoverfly** larvae eat aphids as well as other soft bodied pests. Each can consume up to 1,200 aphids

- **Adult hoverflies** feed on pollen and nectar from flowers
- Larvae and adults hibernate

- **Lacewing** larvae eat aphids. Number consumed by each larva varies but can exceed 1,500

- **Lacewing adults** feed on pollen and lay eggs near aphid colonies
- Adults hibernate

- **Ladybird** larvae eat aphids

- **Adult ladybirds** eat aphids and lay their young near aphid colonies
- Adults Hibernate

- **Parasitoid wasp larvae** keep the aphid alive and feed on it until they are fully grown. They then exit the aphid's body, killing it

- **Adult Parasitoid wasps** attack and lay their eggs inside aphids and repeat the cycle

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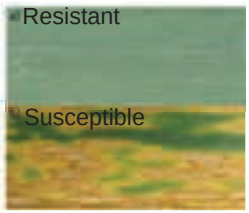
Notes:

Septoria disease of wheat

- The single greatest threat to Irish and EU winter wheat

- STB requires 3-4 sprays through growing season
- European fungicide input - 70% (>€400 million)
- Fungicide efficacy decreasing
- EU Regulation - prohibition of DMI-based fungicides
- **Need wheat varieties with durable resistance, but**
- Breeding novel varieties takes time (7 – 10 years)
- Need high level of genetic diversity in breeding populations



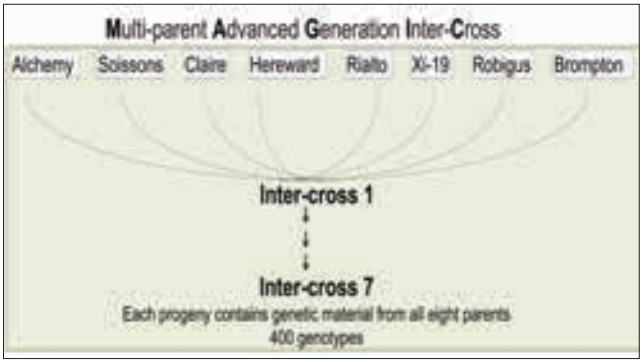
Disease response

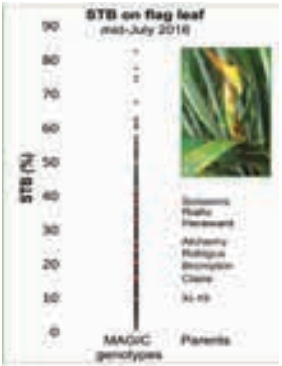
Notes:

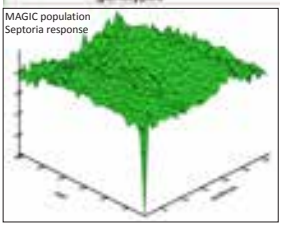
MAGIC winter wheat population

8 parents, with different desirable traits
- yield potential
- grain quality
- disease resistance etc.

Current experiments
Examining the genetic basis of
- Septoria disease resistance
- Nitrogen use efficiency







Research Stimulus Fund
Project 14/S/819

Genotypes & DNA information kindly provided by NIAB

Notes:

Speeding up for disease resistance

Traditional septoria assessment




~ 1 year

The 'Speed breeding' and septoria assessment

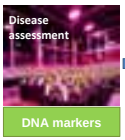




~ 4 months

Combining speed breeding with DNA-based selection for septoria resistance


Training population: DiverseMAGIC



Develop a prediction model

Select and cross best lines

Population improvement ~top 5-10%

New septoria resistant line

DNA- based selection

~1000 lines

Retrain the model

Field testing

. New septoria resistant line in 3 years compared to ~6 years

This work is funded by MARIE SKŁODOWSKA-CURIE ACTIONS Individual fellowships (IF)H2020-MSCA-IF-2017. ProjectGSAS (794040)

Notes:

Managing Septoria

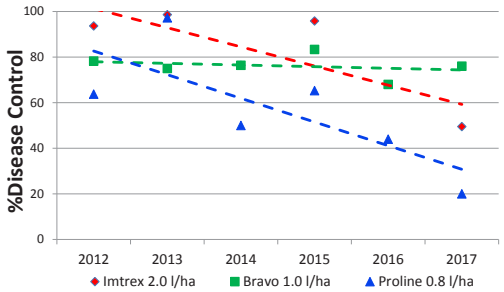
Septoria most economically destructive disease of Irish winter wheat

Varying levels of resistance to both azoles & SDHIs now widespread

New chemistry on the horizon!

Need to protect

Decline in azole & SDHI efficacy



Key to managing Septoria

- Varietal Resistance
- Sowing date
- Fungicide timing
- Fungicide choice

Notes:

Fungicide resistance

Fungicides are essential to the control of cereal diseases

Fungicide resistance has serious & immediate consequences for disease control

Managing fungicide resistance is vital to protect potential yields

Resistance Management – Only Use

…when required

…the minimum dose required

…with mixtures of different modes of actions

Notes:

A future post CTL


Septoria tritici blotch


Ramularia leaf spot

Chlorothalonil has been integral to fungicide programmes over past two decades

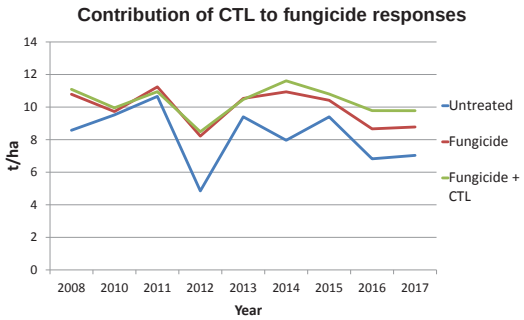
Has become essential fungicide for control of Septoria on wheat and Ramularia on barley

Key multisite in fungicide anti-resistance strategies

From 20th May 2020 its use will no longer be permitted

Key Questions?

1. What are the potential impacts?
2. Are alternative multisites available?
3. Do we need multisite fungicides?
4. Can we rely on varietal resistance?
5. Role of micronutrients?

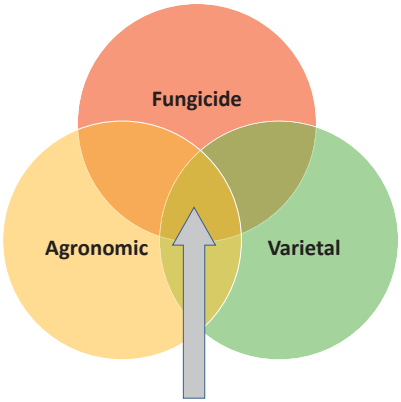


Notes:

Resilience in disease control

- New fungicides on the horizon
- Varietal resistances improving
- Increased awareness of agronomic influences

- All at risk of resistance
- Continued need for fungicides
- Limitations in ability to control diseases



Where we need to be!

To prolong the efficacy of varietal resistance & novel fungicide MoA they need to be carefully managed

Integrated Pest Management

Notes:

Spring barley disease control


Rhynchosporium


Ramularia


Net Blotch


Mildew

Fungicide Timings?

- Late tillering – protect tillers
- GS49 (awns peeping) – protect green leaf
- Loss of up to 0.4 t/ha if left until GS59 (ear fully out)

What to use?

- Use mix of actives
- 50% rate of each sufficent
- Triazole + SDHI/strobilurin
- CTL for Ramularia a must!

Notes:

Managing Ramularia

Control of Ramularia post-CTL

- Potential to significantly reduce yield & quality
- What alternatives available for control?
- Do varieties have a role to play in disease management?

Alternative Chemistries

- Chlorothalonil not permitted after May 2020
- Alternative multisite fungicides?
- New fungicides on the horizon

Future Programmes

- Varietal resistance?
- New/alternative chemistries to CTL?
- Accurate fungicide timing essential

Notes:

Teagasc/Boortmalt
Malting barley development programme

Program Objectives

Improving profitability of malting barley production— Comparable to winter wheat

A targeted knowledge transfer program for latest Teagasc research tailored to each region

Increase nutrient management planning and use

Deliver more brewing and distilling barley delivered per farm within specifications

How will I see the program?

- Increased information flow
- More malting barley events
- Workshops on specific topics
- Increased support for discussion groups
- Contact point for technical assistance

Meeting the Objectives

- Dedicated advisor (Eoin Lyons) for 3 years
- Use Monitor Farms and crops in different locations to track progression
- Working intensively with Teagasc and Boortmalt discussion groups

Contact: Eoin Lyons Teagasc, Enniscorthy, Co. Wexford
Phone— 087-9859894
Email— eoin.lyons@teagasc.ie

Notes:

Progress to date

Improved communication of technical issues

- Crop Walks
  - Winter Malt
  - Spring Malt
- Newsletters/technical bulletins
- Website

Trials and Demos

- 5 Monitor Farms/Crops
- Seedbed consolidation –Wexford
- Crop evaluation - All
- Manganese – Kildare
- Aphid traps – All
- Weather stations – All
- Ramularia monitoring - All
- Precision yield monitoring – Kilkenny

Notes:

Winter oats: Maximising grain numbers

Oat yield - driven by grain numbers

Grain numbers - determined by grains per panicle

Panicle Development

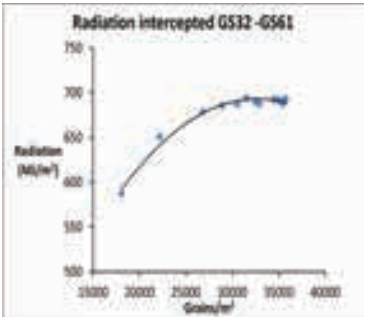
- The oat panicle starts to develop in early spring. First sign of development is a double ridge
- GS30: The basic structure of the panicle has been formed
- GS32: Grain development underway

Notes:

Winter oats: Maximising grain numbers

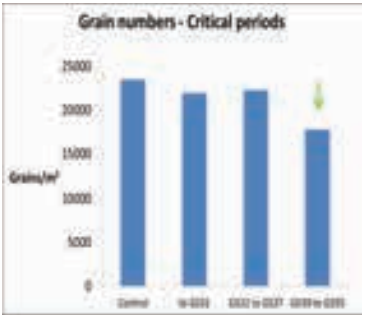
Radiation interception

- **Grain numbers** increase with radiation intercepted between GS32 and GS61
- **Nitrogen** is needed to maximise radiation interception – applied by GS32
- Leaves need to be kept free of disease during this period



Critical period

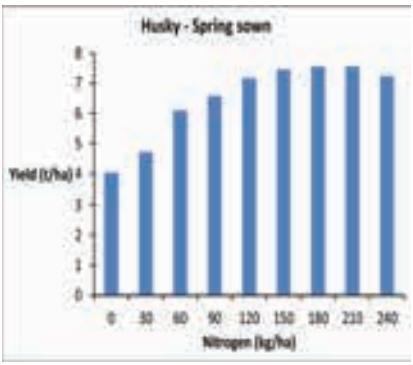
- Final grain numbers determined from GS39 – GS55
- Stress during this period will lead to grain abortion

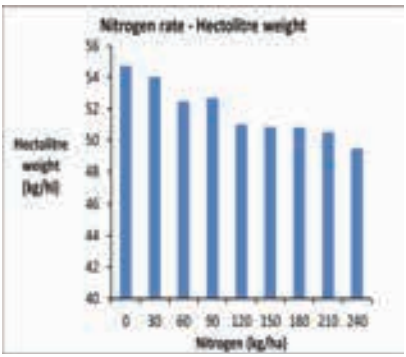


Notes:

Spring oats: Nitrogen fertilization

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



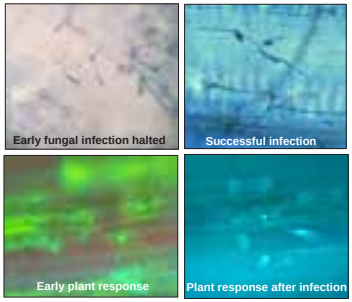


Notes:

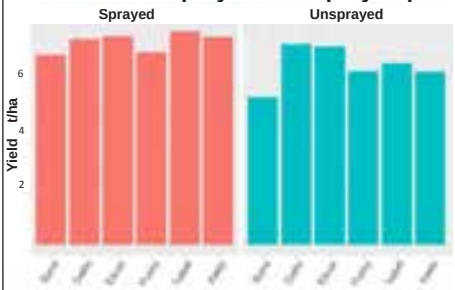
Powdery mildew of oats

Assess varietal resistance in the field + glasshouse

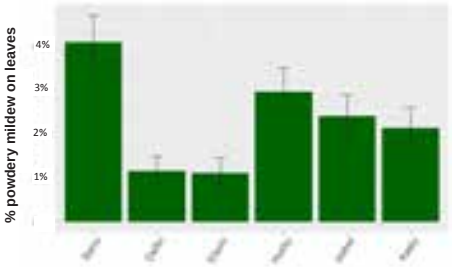
What is the basis of varietal resistance? Assess infection under the microscope



Yield from sprayed & unsprayed plots



Level of powdery mildew infection



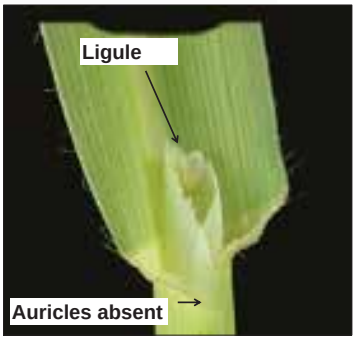
Use of resistant varieties = Protect yields & lower fungicide inputs

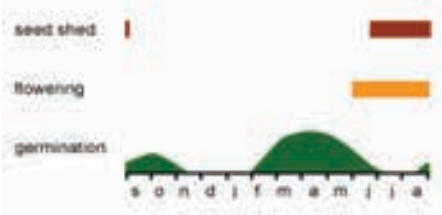
Notes:

Identification of wild oats

Wild oats

- 1 plants/m² = 1% yield loss
- Confirmed herbicide resistance
- Can germinate from depth
- Two species of wild oat - winter and spring
- Require different management strategies



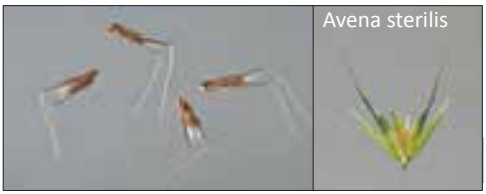


Avena fatua (Spring wild oat)

- Awns **present** on third seed within spikelet
- Seeds separate when mature and shed singly

Avena sterilis (Winter wild oat)

- Awn **absent** on third seed in spikelet
- Seeds remain attached when mature and shed as a unit

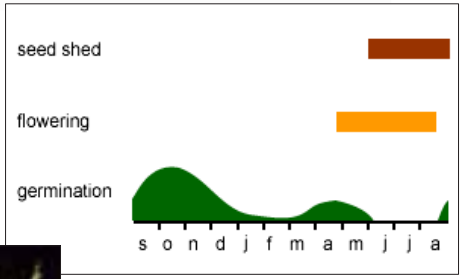


Notes:

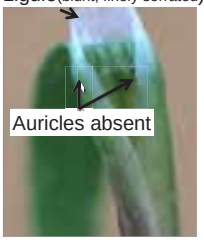
Identification of blackgrass

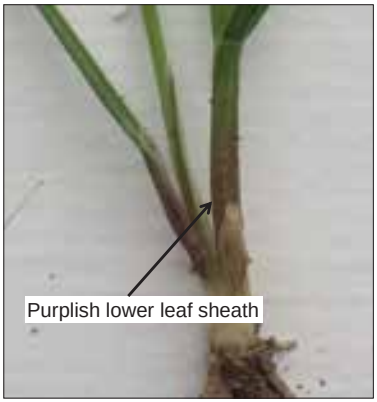
Blackgrass

- 1 plant/m² = 6 million seeds/ha
- 8-12 plants/m² = 2-5% yield loss
- Confirmed herbicide resistance
- 80% of plants emerge in Autumn
- 70% seed decline per year
- Cannot germinate from depth



Ligule(blunt, finely serrated)





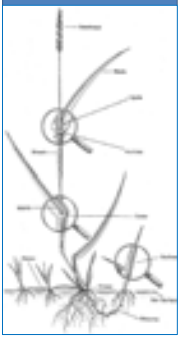
Notes:

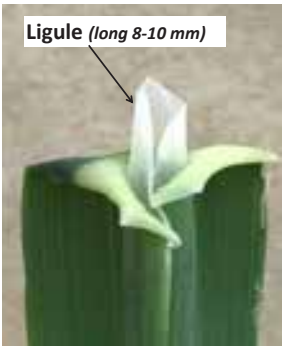
Identification of lesser canary grass

Lesser Canary Grass

- Becoming increasingly common
- In both winter & spring crops
- No confirmed herbicide resistance
- Spring germinator… but
- Seed persists in the soil

How to identify grass



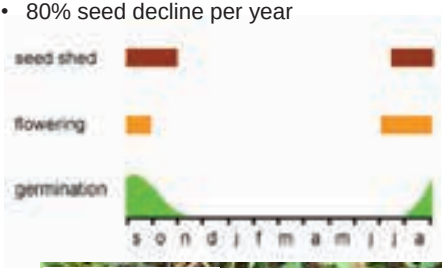


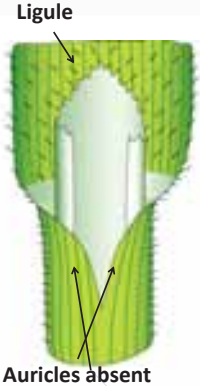
Notes:

Identification of sterile brome

Sterile brome

- Can produce >200 seeds per plant
- 5 plants/m² = 5% yield loss
- Suspected herbicide resistance
- Predominately autumn germinating
- 80% seed decline per year





Notes:

Do you have grass weed problems? Would you like some help?

The project team can help you

- Identify and assess grass weed levels on the farm
- Evaluate why and how management actions drive grass weed pressure on the farm
- Sample grass weeds and test for herbicide resistance
- Provide practical advice to solve grass weed problems
- Capture best existing on-farm management actions and knowledge

Why do some Irish tillage farms with similar systems have

- No weeds?
- Mixed populations?
- Large infestations?
- Resistant weeds?

Our survey will answer these questions

Be part of the project…

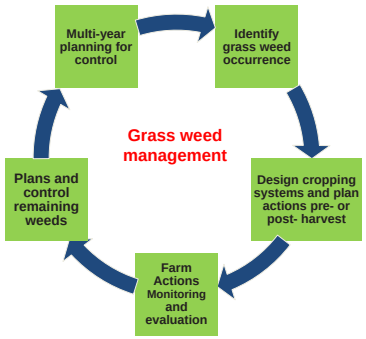
Participate in the Grass Weed Survey

Sign the sheet with name and contact details **today** and we will be in contact

or contact the project team using the below information:

Jimmy Staples (project advisor)
Teagasc, Oak Park, Co. Carlow
W: 059-9170227; M: 087-7907758
E: Jimmy.staples@teagasc.ie

Steps to controlling grass weeds



Please note all information gathered will be kept private and confidential unless otherwise stated by the person of interest

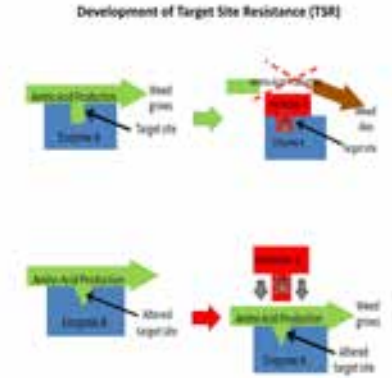
Notes:

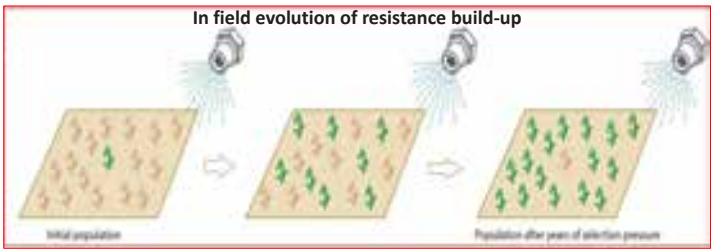
Herbicide resistance

'Herbicide resistance is the ability of a plant to survive and produce seed even after the application of a rate of herbicide that would have normally killed it'

There are 2 main types of resistance:

1. ***Target site*** – the site where the herbicide should act on the weed is blocked by the plants mutations it has developed
2. ***Non-target site (Enhanced metabolism)*** Where the number of herbicide molecules reaching the target site is reduced, either due to detoxification of herbicides to non-toxic metabolites (enhanced metabolism), or sequestration to other parts of plant cells





Notes:

Integrated strategies for managing grass weeds

The past

Farmer practice

The future

Control options

Rotations	Row widths
Stale seedbeds	Rotational grazing
Cultivations	Allelopathy /Bio fumigation
Drilling dates	Nitrogen timing
Seed rates	Mowing/ Whole cropping
Cover crops	Mechanical weeding
Companion cropping	Alternative approaches
Crop cultivars	Targeted Herbicides
Rogueing	Alternative Herbicide types

Implementation

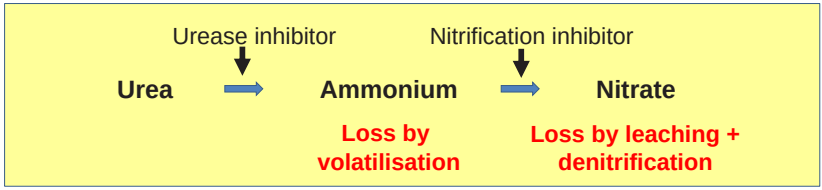
Notes:

N fertiliser types

	CAN	Urea	Protected urea	UAN (liquid N)*
N content (**straight N**)	27	46	46	28-32
Yield	★★★★★	★★★★½	★★★★★	★★★★½
Cost of N	★★★★	★★★★★	★★★★½	★★★★★
Spread evenness **(wide trams)**	★★★★★	★★★★	★★★★	★★★★★
Greenhouse gas	★★★★	★★★★★	★★★★★	★★★★
Ammonia gas	★★★★★	★★	★★★★½	★★★½

*Based on international data

- Protected urea includes products containing NBPT or 2 NPT
- Some products contain nitrification inhibitors also
- Each product has pros and cons – inform yourself before using
- Gaseous losses will receive more focus in future
- Correct rate and timing is important irrespective of fertiliser type

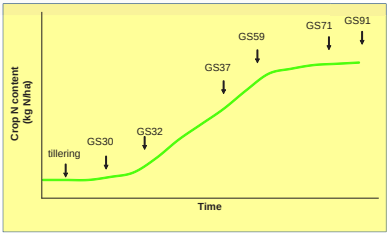


Notes:

N timing and varietal effects

N timing

- Ensure sufficient N to meet crop demand
- Demand is low at early stages
- Most N taken up during stem elongation/heading
- Timing and splitting effects small
  - Provided crop is not allowed to get very deficient



2 split vs 3 split

- Little consistent difference in winter or spring barley
- 3rd split allows final N decision later in season
- Potential for precision ag techniques

Variety effects

- Little difference in N requirement of commercial varieties/variety types

Assuming

- Similar yields
- Same target market

Notes:

Does RYE have a role?

Potential uses

- Distilling/brewing
- Human consumption
- Animal feed, particularly pigs
- Anaerobic digestion

Pros

- Good yield potential
- Good disease resistance
  - Particularly take-all and septoria
- Good drought tolerance
- Lower fertiliser requirement?

Cons

- Tall, lodging is a risk
- Susceptible to ergot
  - Modern hybrids less susceptible
- Sprouting is a risk
- Limited market currently

Knowledge gaps

- Most effective PGR programme?
- Optimum nitrogen rate?
  - Feed vs distilling?
- Optimum seeding rate?
- Optimum sowing date?
  - Vigorous early growth – delay sowing?
- Suitability for Irish pig diets?

Notes:

Winter barley agronomy: Two vs. Six-row

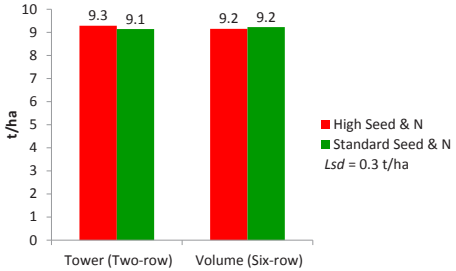
- The introduction of hybrid six-row varieties has led to a number of important management questions
- Such as the requirement for PGR treatment and fungicide timing

Yield components	Two -row	Six-row	Wheat
Ears/m^2	900-1200	650-900	480-600
Grains/ear	17-21	30-40	41-51
Grains/m^2	15,000-25,000	19,500-36,000	19,700-30,600
TGW (g)	50-58	40-45	46-56

A field experiment was carried out over six site/seasons testing fungicide timing and PGR requirement in a Hybrid six-row (Volume) and conventional two-row (Tower) grown at the standard seed & N rates and +25% of these standard rates

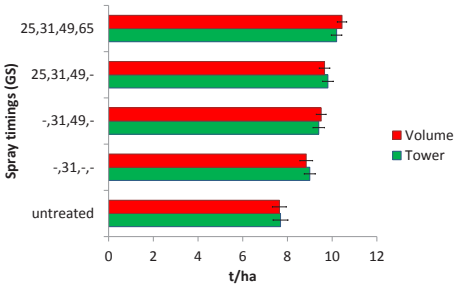
Did increasing seed & N rate increase yield?

- No, yield increase from increasing seed & N rate in either a two or a six-row variety
- Yield was similar in both varieties



Does fungicide timings need to change due to row type?

- No, each row type responded similarly to fungicide timing

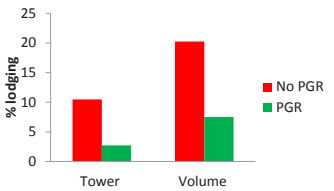


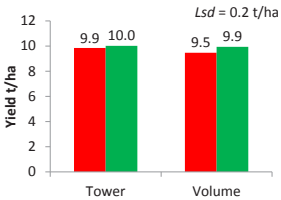
Notes:

Winter barley agronomy: Two vs. Six-row

Do six-rows have a greater need for PGR?

- Yes, there is a greater need caused by increased lodging in six-row variety
- Leading to an increased yield response from PGR treatment in the six-row variety





Fungicides not only controlled disease

- Fungicide treatment significantly reduced the level of straw breakdown (brackling) in both varieties
- Timings at GS31/32 (1 spray) and GS49 (2 spray) having the largest effect.

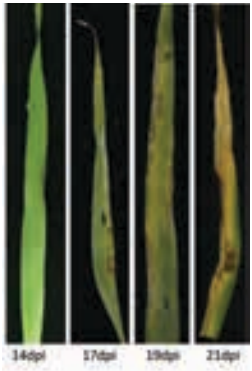
Take home messages

- There is no evidence to suggest changing fungicide timing based on row type
- Six-row varieties have a greater need for PGR application
- Fungicide treatment reduces straw breakdown (brackling)

Notes:

Identifying susceptibility to improve resistance to Rhynchosporium disease

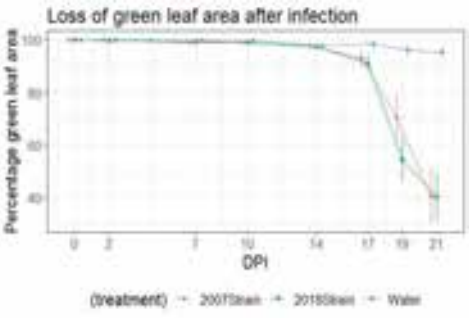
- Rhynchosporium is key disease on winter and spring barley
- Legislative pressures curtailing fungicide availability
- Project goal is to identify novel, durable sources of genetic resistance against Rhynchosporium

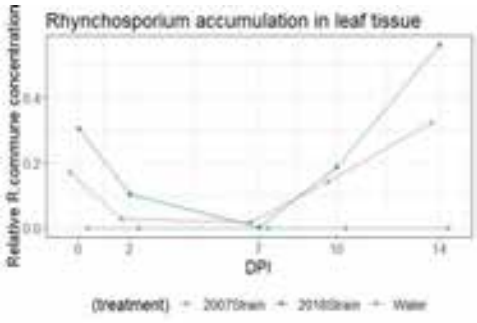


Susceptibility genes (S-genes):

- S-genes are targeted by diseases to promote infection
- Varieties lacking specific S-genes are more resistant
- S-gene based resistance has potential to be more durable than current resistant varieties

Characterisation of disease → **Identify and characterise barley S-genes** → **Generate new barley lines lacking specific S-genes**





Notes:

Ramularia Leaf Spot (RLS)

Identification

- Rectangular shaped lesion
- Reddish/brown colour
- Ring of yellow around lesion
- Restricted by leaf veins
- Right through the leaf

Potential Issues?

- Limited understanding of the disease (since late 1990's)
- Loss of fungicides (resistance developments & legislation)
- Difficult to predict outbreaks

EPIC IPM

Notes:

RLS risks

Is it a problem?

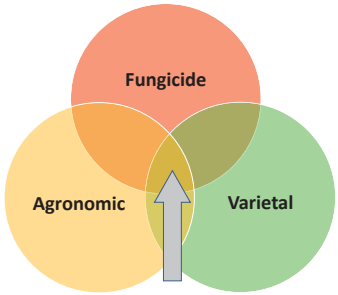
- Yield loss of up to 1 t/ha if untreated
- Resistance to strobs, azoles and SDHI's…
- Limited varietal resistance available
- Loss of chlorothalonil

Key points

- Multiple sources of infection (seed, stubble, airborne)
- Symptoms often only observed post flowering
- Problem exacerbated in stressed crops
- Correct fungicide timing essential for control

Managing the risk

- Grow more resistant varieties??
- Preventative spray at GS 45??
- Try to avoid crops becoming stressed??



Where we need to be!

Notes:

Forestry

Room for trees on your farm?

a whole farm approach – how can trees contribute?

- commercial timber
- soaking up carbon
- improve water quality
- homes for wildlife
- renewable energy

@teagascforestry

TeagascMedia

forestry.teagasc

Teagasc Forestry online: www.teagasc.ie/forestry

Teagasc Forestry e-News: Have you signed up?

Contact your local forestry adviser

Notes:

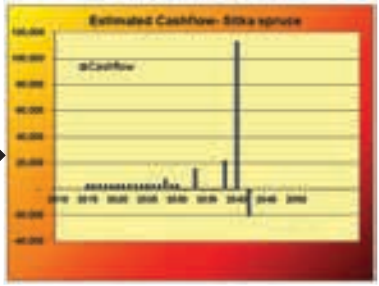
Forestry

Afforestation Grants- Main Points

- afforestation grant covers costs to establish a woodland
- receive both **forestry premium and BPS** on eligible land
- annual premium **€510-€665/ha/year** for **15 yrs**
- reckonable as **Ecological Focus Areas (EFA's)**
- minimum size grant aided: 0.1ha (broadleaves)
- many options: conifers, broadleaves, native woodland, agroforestry etc
- forestry is a <u>permanent</u> change of land use.

EXAMPLE -

- 8 ha Sitka spruce
- Rotation 30 year
- YC 24
- Net profit; €182,000
- AEV/ ha; €696



Notes:

IPM of the Pine Weevil

Integrated Pest Management

Selecting and combining the best possible protection methods for

- minimal ecological disturbance
- minimal risks for human health
- economical viability.

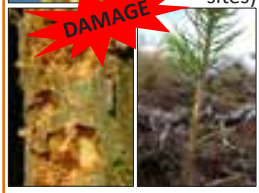
Evaluating Methods

Literature + Stakeholder experience = **Sustainable pest management**

Pine Weevil

Europe's most important reforestation pest

Spring
Adults arrive at site (+resident adults on old sites)



Summer
Larval development

Autumn
Resident + emerging adults

Winter
Dormant

Pictures by F. Fedderwitz, C. Hellqvist and P. Lillis

Notes:

Minor crops: Beans

Why grow faba beans?

- Suited to the Irish climate and soils
- High yielding under Irish conditions
- Excellent break crop
- Nitrogen fixation (reduces the fertiliser N demand of the following crop in rotation)
- Improve soil characteristics
- Valuable native protein source

Challenges growing faba beans?

- Perceived variability in yield
- Limited varietal development
- Lack of specific agronomy information
- Limited disease/pest/weed control options

Notes:

Beans – agronomy

- Variety Selection
- Time of Sowing
- Seed Rate
- Row Spacing
- Cultivation System

Crop Sowing

Crop Maintenance

- Crop Nutrition
- Weed Control
- Pest Control
- Disease Control

- Yield
- Grain/Seed Quality

Crop Performance

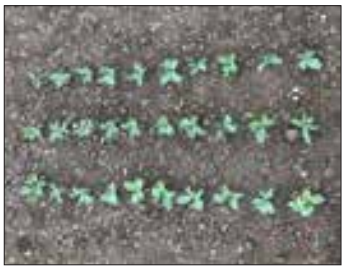
Notes:

Beans – breeding

RSF (VICCI) project

- Focussed on the evaluation of recurrent selection as a method to achieve rapid re-adaptation of faba bean to the Irish agro-climate
- Aims to develop Irish-adapted ideotype combining characteristics of high-yielding and improved ascochyta and/or botrytis resistance

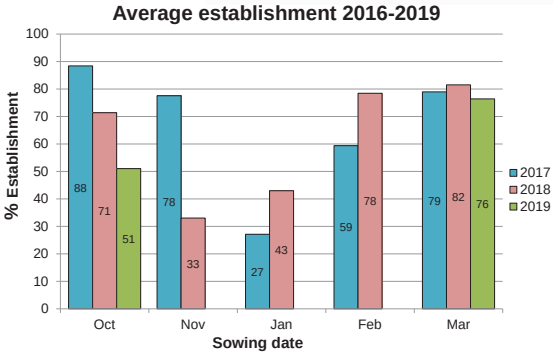
ERA-NET (ProFaba200) project



- Focussed on developing improved Vicia faba breeding practices and varieties to drive domestic protein production in the European Union
- Irish component: screening the varietal panel for Botrytis Fabae resistant varieties

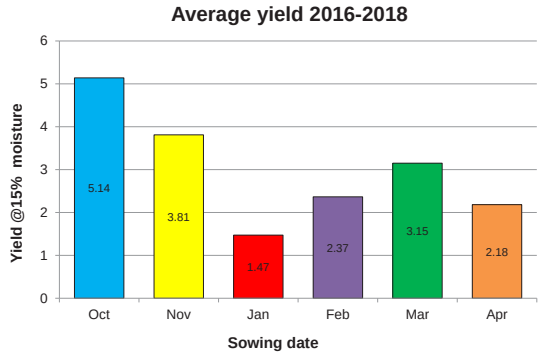
Notes:

Effect of sowing date on yield



Establishment

- Winter variety best established in October
- Spring variety established best in March



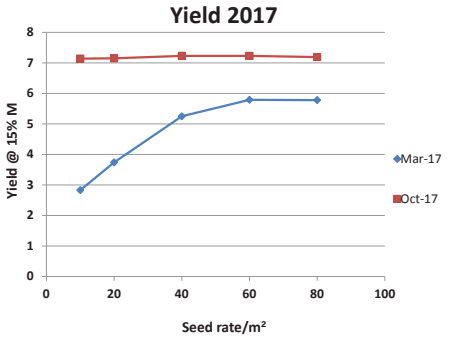
Yield

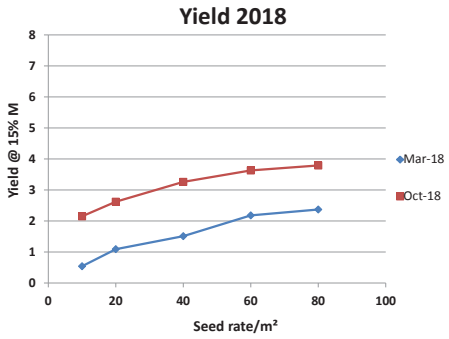
- October sowings gave highest yields for winter variety
- Early Spring sowings (January) attacked by crows
- March yielded best for Spring variety

IFA Grain Levy Supported Research

Notes:

Effect of seed rate on yield





- Higher seed rates have more competition for light, moisture etc.
- Lower seed rates seen to produce more pods – branching
- Lower seed rate yields can be competitive with higher seed rates

2017

- Good ground conditions
- Good establishment
- Desirable weather conditions

Average yield 6.7 t/ha

2018

- Poor ground conditions (snow)
- Good establishment

DROUGHT!

Average yield 2.5 t/ha

IFA Grain Levy Supported Research

Notes:

Sowing dates and seed rates

Summary

Lower seed rates:
- Problems with weed competition
- Lower pods on stems – not easy to harvest

Higher seed rates:
- Run the risk of lodging
- Less manageable at harvest

35-45 seeds/m²:
- Gives a manageable crop
- Average yields 5-6t/ha

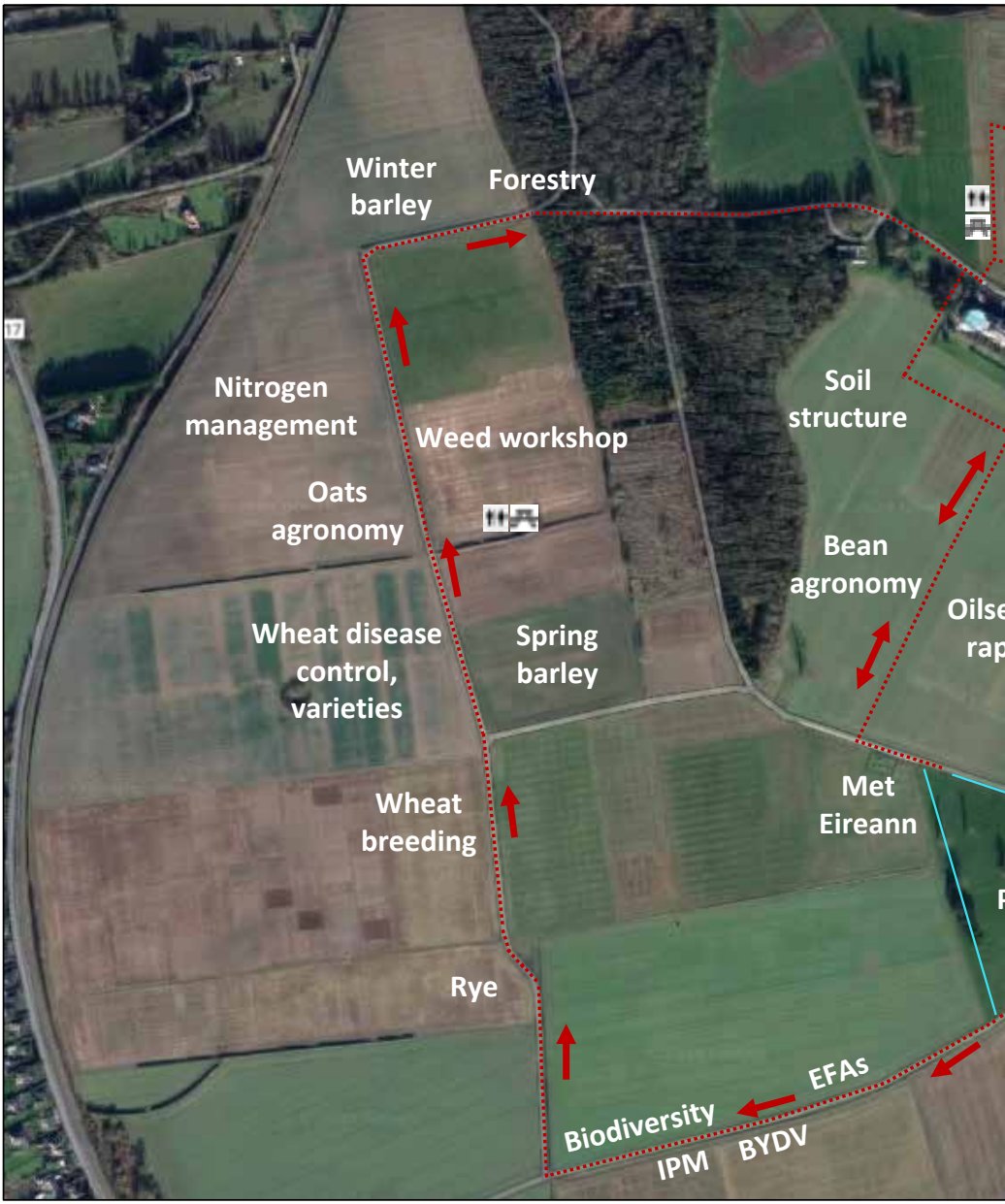
Watch out for crow damage on late winter and early spring sowings!!

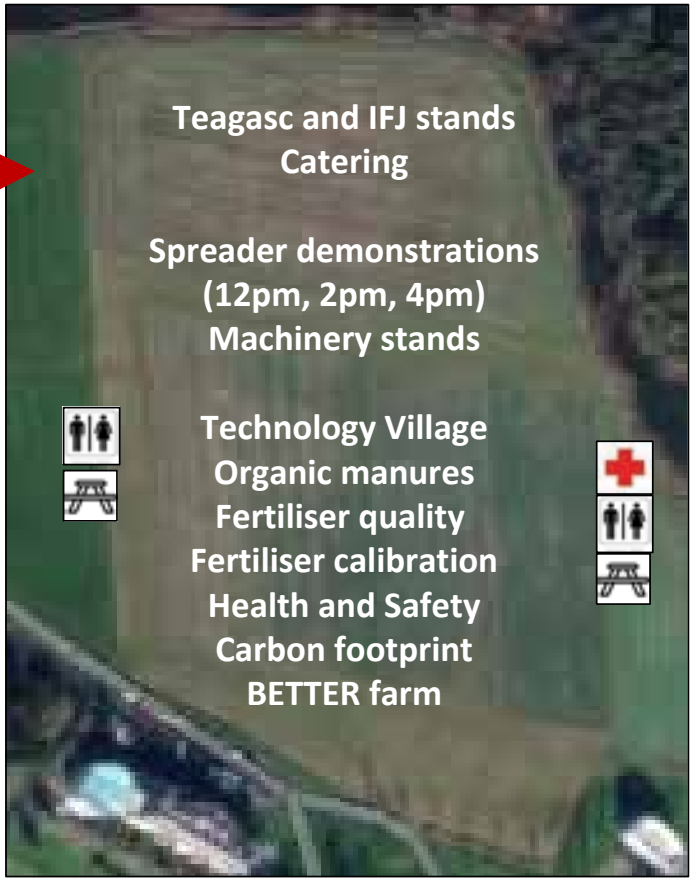
Take home message

- Avoid crow damage by sowing early winter (Oct) and later in spring (Feb/Mar). Good ground conditions and rolling also recommended
- Recommend to sow at 40 seeds/m². No difference in yield between 40, 60 and 80 seeds/m²
- Good establishment and management at early growth stages is crucial for final harvest yields

IFA Grain Levy Supported Research

Notes:


Winter barley
Forestry
Nitrogen management
Weed workshop
Soil structure
Oats agronomy
Bean agronomy
Oilse
rap
Wheat disease control, varieties
Spring barley
Met Eireann
Wheat breeding
Rye
EFAs
Biodiversity
IPM
BYDV



Event app: cropsopenday.ie

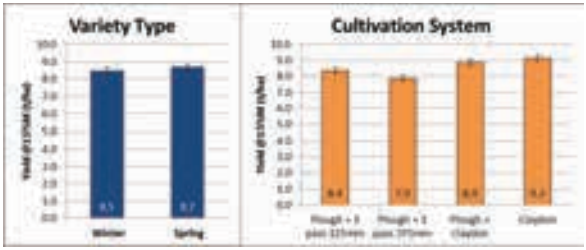
Beans – cultivations

OPTI-BC Project (RSF)
Impact of cultivation system and sowing date on establishment and yield

How?
- 4 years
- 2 sites
- 3 sowing dates

Oct, Feb, Mar
- 4 systems

Plough + 1 pass 125 mm
Plough + 1 pass 375 mm
Plough + strip drill
Strip drill into stubble

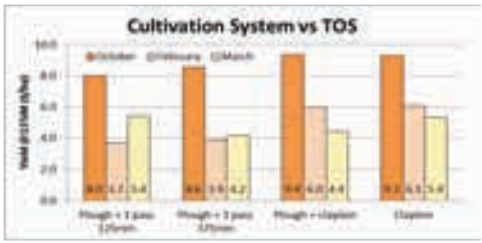


Winter sown

Spring & winter varieties

- **No differences between variety types in winter sown trials**
- **Strip drill yield higher in Oct and Feb but not in Mar**

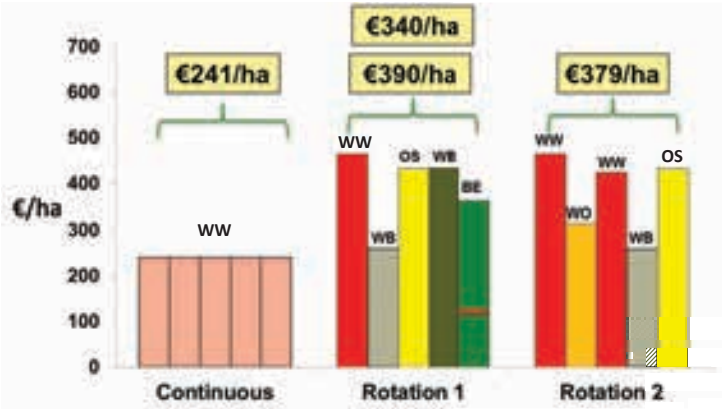
Measurements?
- *Establishment*
- *Growth*
- *Yield*
- *Yield components*
- *Leaf area*
- *Disease assessments*



Spring Variety

Notes:

Rotations have value !



Crop and rotation annual margins **(beans BE with and without protein payment)**

- Break crops bring value to the following crops
- Must value entire rotation not single crops
- Consider benefits such as weed control, different markets etc.
- Break crops not all that volatile

Notes:

Establishing OSR

Why consider alternatives to ploughing?

- **Less expensive**: can be half the cost, depending on depth and intensity
- **Faster**: allowing OSR to be established quickly during busy harvest period
- **Reduced cultivation** can be applied across a rotation.

Oak Park Research

- Plough, Min-till and Strip-till evaluated
- Row widths of 125mm to 750mm and N response checked
- Row widths up to 600mm satisfactory
- Strip-till yielded similar to plough-based in 7 of 9 trials, but poorer establishment (variable seed depth) reduced yield in two
- Min-till (shallow tine cultivation and Vaderstad drill) also satisfactory
- Similar N and seed rate response across systems

Notes:

OPTI – BC: OSR management

Questions addressed

- **Which is best. Early sown 'big' biomass or Later sown 'small' biomass?**
- **Does defoliation (bird damage) impact on the response?**
- **How should we manage crops with different post winter canopy structures?**

Research programme

- 3 sowing dates: Aug15th, Sep 1st, Sep 15th.
- 2 post-winter defoliation regimes: Uncut and mechanically defoliated
- 7 N management approaches including 'fixed' and canopy management
- Year 2 of 3 year trial

Measurements

- Establishment
- Biomass / GAI through season
- Light interception
- Pre-harvest yield components
- Final Yield

Notes:

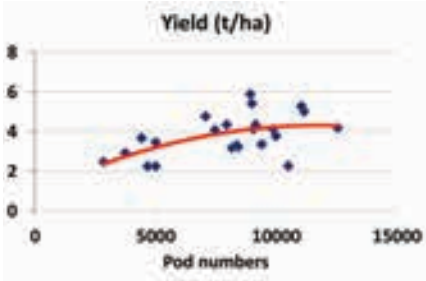
OPTI – BC: OSR survey

Grower survey, Why?

- Establish the range of crop performance in establishment, growth and yield
- Examine the impact of climate, weather and management
- To determine the prevalence of key diseases

Where and What's being collected?

- 20 crops / sites each year, 3 years
- 11 counties in 2018
- 4 visits:
  - Establishment
  - Post winter
  - Flowering
  - Pre-harvest
- Yield from grower returns
- Detailed management questionnaire



2018 Survey: Pod numbers and yield

Notes:

OSR: Key diseases

Light Leaf Spot (LLS)

- Key disease in our climate: Yield reductions up to 30%
- Early spring control essential even when leaf cover stripped by pigeons
- Varietal resistance should be exploited

Phoma

- Causes Stem Canker
- Potential yield losses >10%
- Treat when10-20% plants infected

Sclerotinia

- High risk in tight rotations

Disease Control:

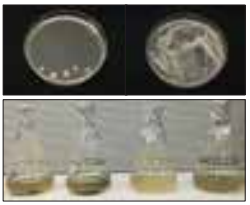
- **Choose varieties carefully**
  - November (for Phoma and LLS. Use $^1/_2$ rate triazole)
  - February (for LLS. Use $^1/_2$ rate triazole)
  - ± March PGR fungicide (@green bud stage)
  - ± April (for Sclerotinia @ early petal fall)

Notes:

OSR – Light Leaf Spot understanding populations

Pyrenopeziza brassicae – A pathogen infecting oilseed rape



Population analysis

Irish populations have been sampled in 2019

Molecular analysis on-going

Sensitivity to the azole, SDHI and QoI fungicides to be determined

Detailed sampling + Genomic & Phenotypic analysis = Population Dynamics

How can understanding *P. brassicae* help OSR production?

- Do differences exist in the Irish population, e.g. fungicide sensitivity?
- Should control be focused on field, county, region or country basis?
- When should control measures be applied – before or during epidemics?

Notes:

Soil structure damage

Have you soil compaction problems on your farm?

- Poor crop growth in certain parts of the field
- Poor drainage and surface water ponding e.g. headland areas

Identifying the problem:

- Examine your soil
- Methods for assessing soil structure/compaction
  - VESS – top soil
  - Double Spade VSE- subsoil

Identifying the threats:

- Heavy machinery
  - Excessive axle loads
  - Inadequate tyre size
- Continuous annual cropping
- Working in wet conditions
- No soil cover

Select suitable solutions:

- Avoid wet soil conditions
- Lighten the load
  - Controlled traffic systems
- Enhance soil structural stability
- Apply manure / crop rotation etc.

Take home messages!

- Identify problem - monitor soil structure regularly!
- Identify poor management - Prevention is better than cure!
- Take corrective action – is soil specific management is needed?

Notes:

Soil structure damage

Have you soil compaction problems on your farm?

- Poor grass growth in certain parts of the field
- Poor drainage and surface water ponding e.g. headland and gateway areas

Identifying the problem:

- Examine your soil
- Methods for assessing soil structure/compaction
  - GrassVess – top soil
  - Dig a pit - subsoil

Identifying the threats:

- Heavy machinery
  - Excessive axle loads
  - Inadequate tyre size
- Continuous cropping
- Working in wet conditions
- Extended grazing

Apply solutions:

- Avoid wet conditions
- Controlled traffic systems
- Lighten the load
- Enhance soil structural stability and resilience

Take home messages!

- *Check your structure regularly!*
- *Prevention is better than cure! Safeguard your soil.*
- *Know your soil type! Soil specific management is needed!*

Notes:

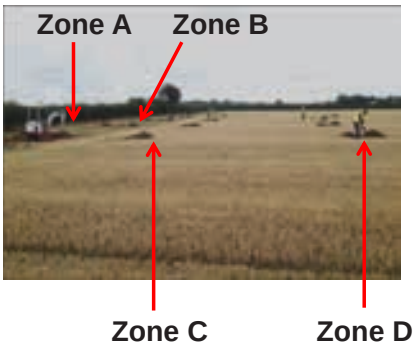
Soils & crops on headlands

Headland studies: Survey

- 40 tillage field headlands
- Assessments of:
  - Soil structure
  - Crop performance
  - Input application
- Scope for improved headland management will be determined

Preliminary results

- Soil structure is impacted by zone
  - Zones C & D better than zones A & B
  - Visual methods tell more than quantitative methods (bulk density)
- Crop performance is impacted by zone
  - Lower yields on headlands
  - Lowest at zone A, not where most turning occurs (zone B)
- Variable fertiliser applications in zone A (next to field boundary)



Notes:

Fertiliser demonstrations

Live Demos: 12pm, 2pm, 4pm.

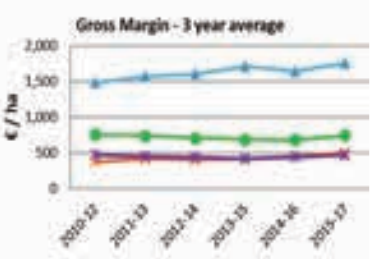
- Machines description and commentary
- Highlighted on big screen
- GPS controlled spreading live
- All aspects of spreading discussed

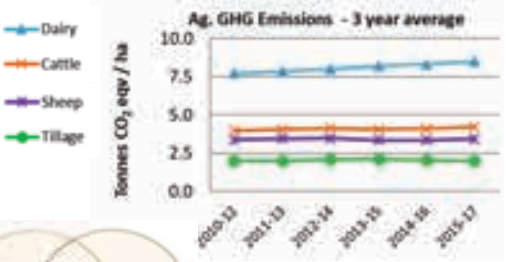
Supporting stands

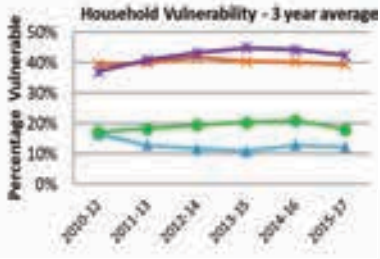
- Setting the spreader to spread evenly
- Calibration and tray tests
- Organic manure field demo plots
- Dose response in rotation demo plots
- Fertiliser planning: NMP and Tillage
- Climate change and fertilser use
- Safety when handling fertiliser

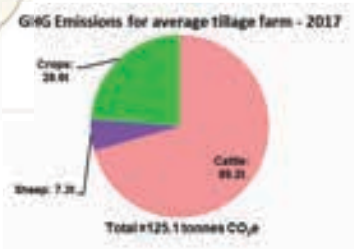
Notes:

Sustainability metrics – Irish farm systems









Key Messages:

- **Profitability and household vulnerability of tillage farms is ahead of livestock systems but behind dairy systems**

Key Messages:

- **GHG emissions per ha are lowest on tillage farms**
- **Majority of GHG emissions on tillage farms are from livestock enterprises**

Notes:

Reducing the carbon footprint of tillage

The C footprint is already low

- The C footprint of the main tillage crops is between 0.3 -0.6 $kgCO_2e$ per kg grain

Reduce mineral N and improve soil organic matter

- Optimise soil pH, P and K
- Where possible use organic manures
- Optimise N application to growth
- Use cover crops to reduce winter fallow
- Utilise appropriate rotations

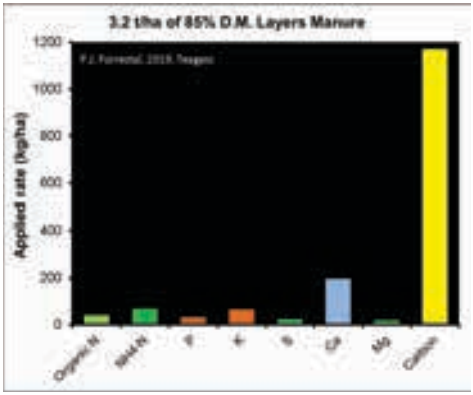
Measure	N_2O	Soil Organic Matter
Organic Manure	👍👍👍	👍👍👍
Cover Crops	👍👍	👍👍👍
pH, P and K	👍👍👍	-
Straw incorporation	👍	👍👍
Minimum tillage	👎	👍
Optimise N	👍👍	-
Rotations	👍👍	👍

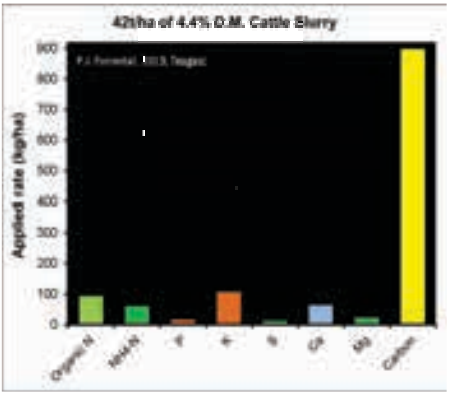
Notes:

Manures for nutrients & soil health

Manure delivers nutrients & builds long-term soil health:

- Build organic matter ✓
- Feed soil biology ✓
- Stabilise soil structure ✓
- Build cation exchange capacity ✓
- Multi-nutrient source ✓
- Potential for cost savings ✓



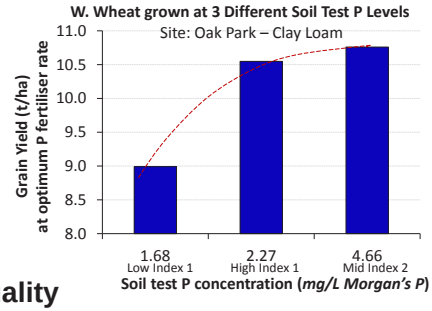


Notes:

Soil fertility targets

Why Build Soil Fertility?

- **Higher yield potential**
  - Winter Wheat + 1.5t/ha
  - Spring Barley + 2.0t/ha
- **Improved crop establishment**
- **Efficient fertiliser use**
- **Healthier crops**
- **Lower variability in grain & quality**
- **Increase profitability**



Soil Fertility Targets

- ✓ **pH 6.5 to 6.8**
- ✓ **P Index 3 (>6.0 mg/L)**
- ✓ **K Index 3 (>100 mg/L)**

Notes:

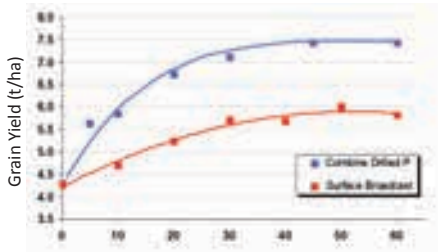
Role of Phosphorus (P)

P is essential for crop establishment

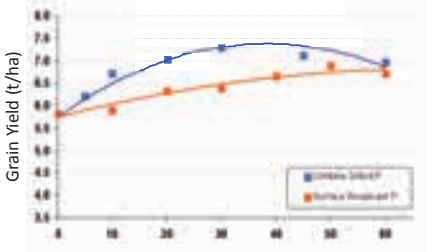
- Supports early plant growth
- Drives plants energy cycle
- Plant root establishment
- Tiller development
- Seedling survival when soils are cold

P fertiliser application method on low P fertility soils

Spring Barley: P Index 1 Soil



Spring Barley: P Index 2 Soil



Notes:

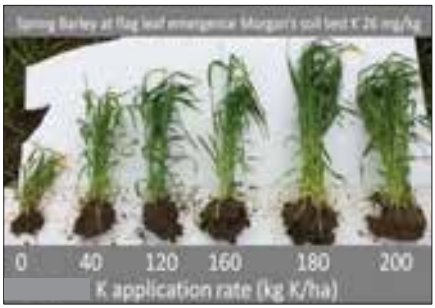
Role of Potassium (K)

K is important for nutrient cycling and robust crops

- Increased nitrogen efficiency
- Improved disease resistance
- Drought tolerance
- Reduced straw breakdown

K fertiliser drives tiller survival & supports grain fill

- Cereals have high K demand
- Top up K based on crop yield
- Monitor K using soil tests
- Apply high K compound
- Consider MOP 50% K fertilizer

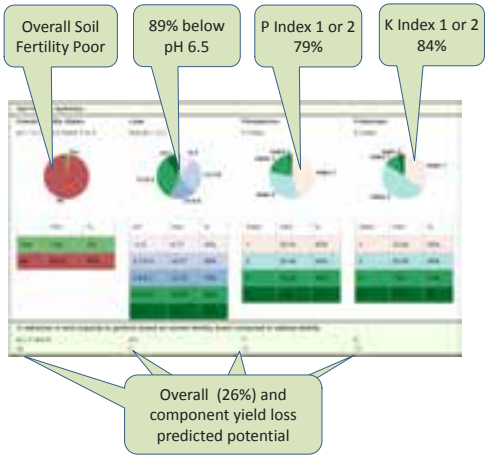


Notes:

NMP online – fertiliser planning

Know your Soil Fertility
- pH and lime requirement
- Soil P
- Soil K
- Overall Fertility

NMP Online Fertiliser Plan Combining
- Teagasc Recommendations
- Nutrient advice maps
- Nitrates Limits



Soil pH and Lime Map

Soil P Index and Organic Manure Map

Plan your Lime & Fertiliser to
- Build soil fertility
- Increase fertiliser efficiency
- Maximise crop yields

Notes:

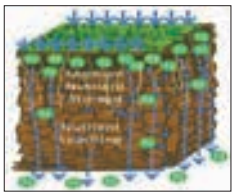
ASSAP – Reducing nutrient loss from farms

Phosphorus (P) Loss From Farms

- Most losses from low permeability soils
- Heavy rainfall leads to overland flow of water
- P and soil sediment washed off into drains & streams

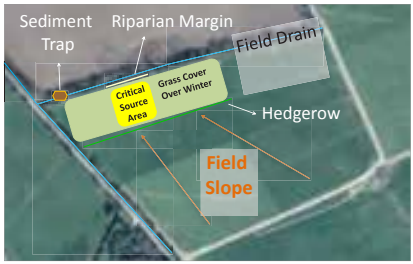
Nitrogen (N) Loss From Farms

- Most N losses from free draining soils
- N does not bind tightly to soil
- Leaching occurs where more N applied than plant needs
- Excess N is *leached* by rain to water

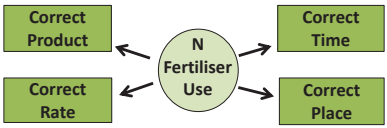


Take Home Messages

• P – 'Break the Pathway'



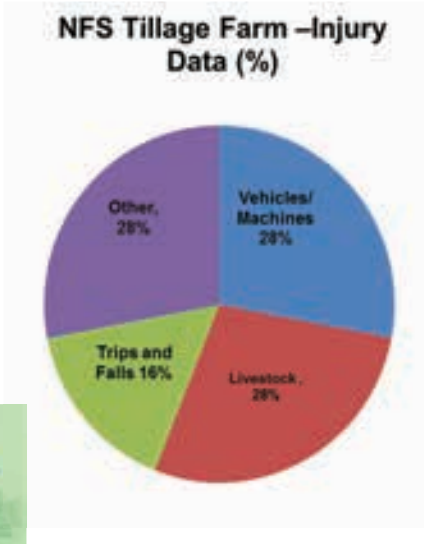
• N – 'Optimise Use'



Notes:

Health & safety on tillage farms

- Tillage Farms – Injury 71% Increase (Teagasc, NFS: 2018)
- Over last 15 years, 19 farm deaths occurred on Tillage farms
- Manage Farm Health and Safety by Completing a Risk Assessment



Notes:

Emptying big bags safely

- Check machine safety e.g. hand-brakes, hoses, linkages
- Ensure bag is safe
- Loosen fertiliser in bag base before unloading- gently move up & down loader
- Always stand to one side of spreader/bag
- Use long knife on pole to open bag
- Open narrow slit to control flow

Use a knife with a long handle to cut the bag.
Never walk under suspended load!

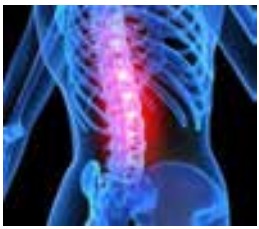
Notes:

Prevent low back pain

- 37% of Farmers have low back pain
- Avoid heavy lifting
- Prevent trips and falls –Tidy farmyards
- Training in Manual Handling

Musculoskeletal injury among Irish farmers

Debilitating spinal injury



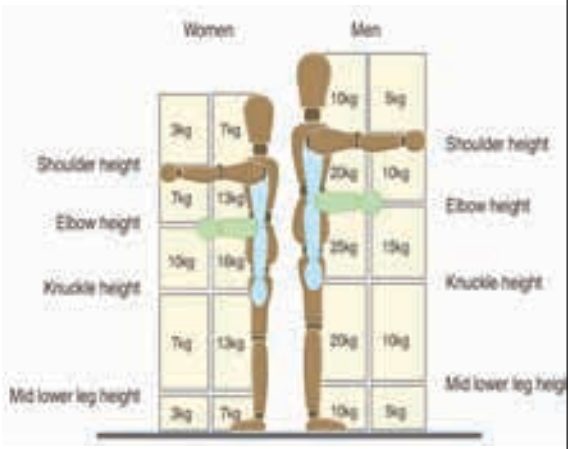
Use mechanical aids

Notes:

The lifting challenge

- Check the weight **before** you lift
- Estimate the weights of objects

H.S.A. maximum lifting guidelines

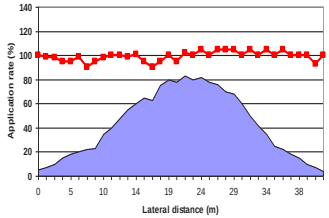


Notes:

Selecting the spreader

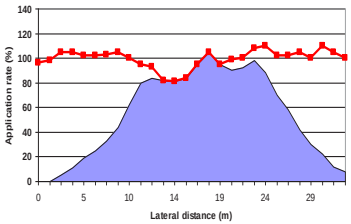
Key Spreader Factors

- Determine bout width and fert type
- Low CV and good spread pattern
  - Value independent tests more
  - With correct bout and fertiliser
- Easy set and not too sensitive
- Good headland spreading system



Setting / Adjustment support:

- Comprehensive spread test database
- Easy to match fertiliser to database; particle size, strength, shape, density
- Website, App or detailed manual
- Easy to calibrate: flow bag; weigh cells; full machine calibration



Notes:

Setting the spreader

Evenness:

- Characterise fertiliser physical quality: Size, shape, density, strength
- Use App or Web to access database
- Set accordingly: disc, speed, vanes and position, drop point, angle
- Check pattern if needed

Notes:

Calibrating the spreader

Calibrating application rate:

- Essential as flow rate varies with:
  - Fertiliser type
  - Batch
  - Weather
- Use manufacturers database as starting point
- Calibration ‘flow-bag’ is accurate
- On-board weighing simplifies task
- Full machine calibration
  - Remove disc, run machine, weigh

Notes:

Fertiliser physical quality

Impacts hugely on spreading

- Size, shape, density and strength
- Impacts throw and movement in air
- 80% in 2 – 4 mm range; larger better
- Rounded and smooth better
- Blend components should be similar
- Strong particles that don't break

Urea is a bigger challenge

- 75 – 80% of density of std. fertiliser.
- Will not throw as far
- More impacted by wind
- Be careful with wide bout widths
- Choose bigger sizes
- Urea blends must have proven spread characteristics

Notes:

Technology Village




Innovations in plant breeding

Notes:

Technology village: Innovations in plant breeding

Our technology village at this year's Crops Open Day will provide an overview of research and development work carried out at Oak Park in support of plant breeding. Plant breeding has been a major contributor to agricultural productivity over the last fifty to sixty years. Breeding improved varieties of crop plants is a cost-effective strategy for reducing inputs, while maintaining or increasing yields. Teagasc breed new varieties of perennial ryegrass, white and red clover, and potato, and these breeding programmes are supported by research into improved breeding methodologies, and the development and deployment of new breeding tools. Teagasc also conducts pre-breeding research in a range of cereals and legumes in support of breeding varieties that will thrive under Irish conditions. Given the challenge to produce more from less and ensure our crops are resilient in the face of a changing climate, it is now more important than ever that the latest technologies are utilised to breed resilient crops. Our technology village will highlight a selection of these innovations:

- **Virtual Irish Centre for Crop Improvement (VICCI)**
  - an overview from *Dan Milbourne* on the latest research in VICCI, which brings together plant scientists across Ireland to address key challenges affecting Irish agriculture
- **Rapid development of DNA tools to develop disease resistant varieties** – *Fergus Meade* will explain how he has developed new DNA markers linked to regions of DNA conferring greater resistance to diseases, which he is using to accelerate the development of new disease resistant potato varieties
- **A new low cost DNA fingerprinting tool** – the ability to survey a plants DNA at a low cost is a requirement for many breeding applications. *Maria de la O Leyva Perez* will discuss the work she has been doing to develop such a system in potato
- **First Irish red clover variety** - a new red clover variety, FEARGA, has been bred by *Patrick Conaghan* at Oakpark. Red clover is an ideal break crop to improve soil structure and fertility
- **DNA assisted plant breeding** – using DNA based selection offers an opportunity to accelerate genetic gain in breeding and *Katie Hetherington* will explain how she is using these tools to increase forage yield of clover
- **Taking advantage of hybrid vigour** – *Abel Gari Teshome* will talk about his research into developing approaches to capture hybrid vigour during commercial seed production that can lead to higher yields in forage crops
- **Screening for flooding tolerance in winter barley** - increases in rainfall are causing significant losses in our winter crops. *Tomás Byrne* will discuss key traits that will allow future cultivars of barley to tolerate flooding

- **New tools for faba bean breeding** – *Vicky Tagkouli* from the University of Reading will discuss the establishment of a new recurrent selection breeding programme within VICCI targeting Irish growing conditions
- **Lab-On-a Chip to detect plant pathogens –** *Michelle Della Bartola* will explain how he is working on a project to develop new biosensors to detect two important pathogens, potato virus Y and *Rhynchosporium commune*
- **Speed-breeding for septoria resistance –** speed breeding was inspired by NASA experiments and *Adnan Riaz* will explain how he is using this technology in combination with rapid seedling assessments to identify and advance lines with greater disease resistance

Virtual Irish Centre for Crop Improvement

Six Crops






Four Challenges

Nutrient Use Efficiency

- Understand the genetics of NUE in breeding germplasm
- Develop high energy, low-N grain for monogastric feed
- Reduced N emissions and crop nutrition costs

Disease Resistance

- Need Irish-adapted varieties resistant to STB and FHB
- Identify germplasm, genes and markers associated with resistance
- Provide tools and information to breeding companies

Abiotic Stress Tolerance

- Low temperatures and flooding can limit productivity
- Investigate breeding germplasm using combined “omics” and field approach
- Develop tools for breeding stress tolerant varieties

Import Substitution

- Beans - potentially useful break crop and could help replace soy meal
- 200K tonnes of fresh/frozen potatoes imported annually
- Develop genomics driven breeding for these crops

Virtual Irish Centre for Crop Improvement
www.vicci.ie

Notes:

Virtual Irish Centre for Crop Improvement

What is VICCI?

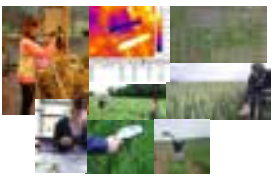
VICCI brings together crop and plant scientists from five institutions to address some of the most important challenges to Irish tillage and forage agriculture

Elite and adapted collections of six Irish agricultural crops from a variety of sources

Controlled environment and field-scale phenotyping of target traits for real world relevance

Multidisciplinary "-omics" approach to understand genetics and physiology of traits

Biotechnology-based tools (eg markers) and advanced germplasm to enable breeding of high performing Irish adapted crop varieties



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Notes:

Tolerance to flooding in winter barley

Selecting Tolerant Cultivars

- Flooding creates low oxygen conditions for the crop
- Waterlogging caused an average of 68% grain yield reduction and and a 45% biomass reduction
- To breed flood tolerant crops we identified tolerant cultivars and traits that confer tolerance

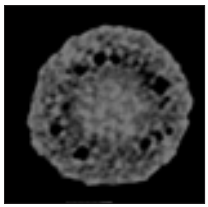
420 winter barley cultivars split into:

Tolerant cultivars

Sensitive cultivars

Adaptations to flooding

- We have identified root and shoot traits that contribute to tolerance to flooding
- We have identified several genes that allow for tolerance
- Aerenchyma (air pockets) have been identified in the roots of flood tolerant barley using CT-scanning
- These traits can be bred into new cultivars

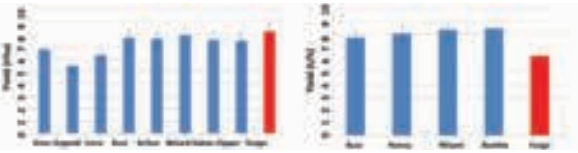


This work has been funded by DAFM RSF Project 14/S/819

Notes:

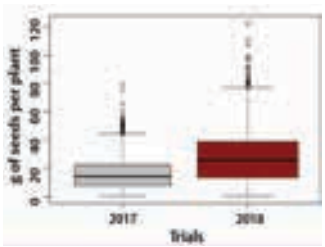
Recurrent Selection for high yielding Irish adapted faba beans

The Seasonal Type Paradox



Autumn-sown field trials show a ***spring*** variety – Fuego – outyielding ***winter*** varieties when disease pressure is low

Recurrent Selection 2016-19 and Preliminary Results



In-between cycles:

	2017	2018
No of harvested plants	1,454	1,581
Yield (kg)	23.8	44.5
Average seed number/plant	27.4	47.5
Average seed weight (g)/plant	16.4	28

Notes:

First Irish red clover variety

What is red clover?

AGRONOMY

- Legume
- Erect growth habit (20 to 80 cm tall)
- Perennial with 2 to 4 years lifespan
- Grown as monoculture or with ryegrass
- Primarily used for silage production
- Not persistent under continuous grazing

BENEFITS

Nitrogen fixation:

- 150 to 200 kg Nitrogen/ha/year
- Reduces dependence on inorganic N

Ideal break crop:

- Improves soil structure & fertility
- Green manure crop - mulch/plough in

High yields:

- 12 to 15 t DM/ha

High feeding value:

- High protein content
- High animal intakes
- Greater animal performance than grass silage

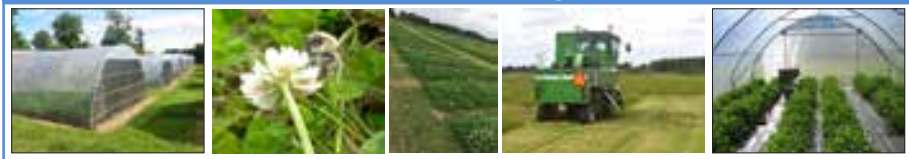
FEARGA: new red clover variety

- First Irish red clover variety, named **FEARGA**, bred at Teagasc Oakpark
- While no official red clover trials in Ireland, **FEARGA** has completed official UK trials
- **FEARGA** is highest yielding red clover in UK:
  - + 22% and 31% higher yield than Merviot in 2nd & 3rd harvest years
  - + 54% higher autumn ground cover than Merviot in 3rd harvest year
- **FEARGA** is the foremost red clover variety for Irish farmers

Notes:

DNA-assisted plant breeding

White Clover Breeding Process



What is DNA-assisted breeding?

DNA Analysis

Measure Traits

Develop statistical models

Offspring

DNA analysis

Predict breeding value from DNA information

How can DNA selection help white clover breeding?

It allows us to (i) reduce the length of a breeding cycle, and (ii) increase the number of plants we assess; meaning we can make greater gains sooner

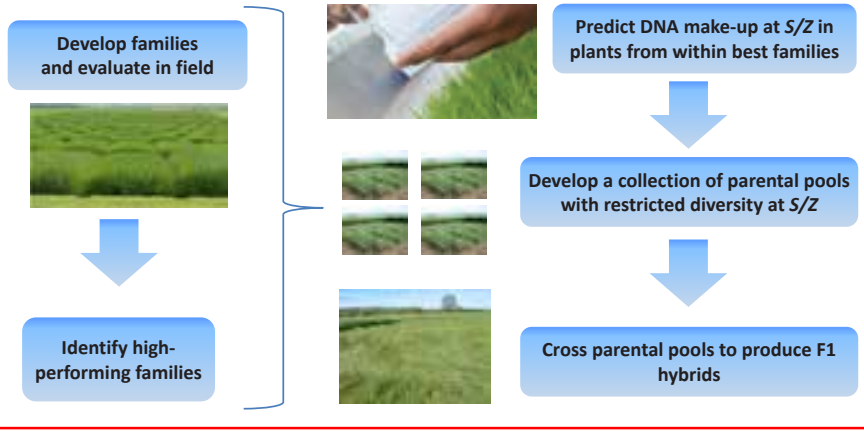
Notes:

Exploiting hybrid vigour

What is SI-based F1 Hybrid Breeding

- Crossing genetically distinct lines results in hybrid vigour
- Need a method to exploit hybrid vigour during commercial seed production
- DNA regions controlling Self-Incompatibility have been identified (S/Z)
- Develop parental pools with restricted diversity at these regions (using DNA markers predictive of composition at these regions)

Implementation



Marie Sklodowska-Curie Actions COFUND Grant Agreement no. CLNE/2017/364

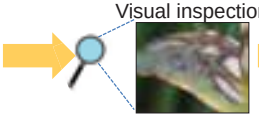
Notes:

A Lab-on-a Chip platform for detection of Plant Pathogens

Current methods for detection of plant diseases

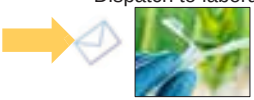
Symptomatic plant

Visual inspection



- Unable to detect pre-symptomatic infections
- Difficult to associate non-specific symptoms with disease

Dispatch to laboratory



- Requires trained lab staff
- Expensive
- Slow turnaround time

Alternative methods to support rapid in-field detection?

- ✓ Field-based
- ✓ Cheap
- ✓ User friendly
- ✓ Rapid (minutes)

Developing a portable device, based on a nano-sensor coated with pathogen-specific antibodies. Goal is to be able to detect specific plant pathogens in symptomless tissues

Advantages of a Lab-on-a chip

- Generated with antibodies specific for different crop diseases (e.g. Leaf Scald, Potato Virus Y)
- Detection performed directly by farmers, advisors and inspectors
- Provides precise decision support (e.g. fungicide applications, rogueing of infected plants)
- Integrated control of the disease, avoiding further spread of the pathogen with tailored inputs

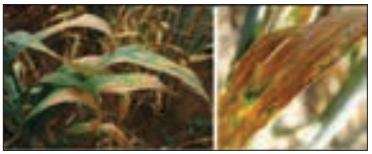
SCOPE – a novel surveillance system for sensing crop diseases of economic importance (DAFM RSF Project 15/S/618)

Notes:

Speeding up for disease resistance

Traditional septoria assessment





~ 1 year

The 'Speed breeding' and septoria assessment

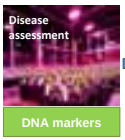




~ 4 months

Combining speed breeding with DNA-based selection for septoria resistance


Training population: DiverseMAGIC



Develop a prediction model

Select and cross best lines

Population improvement ~top 5-10%

New septoria resistant line

DNA- based selection

~1000 lines

Retrain the model

Field testing

. New septoria resistant line in 3 years compared to ~6 years

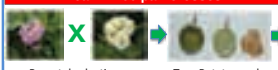
This work is funded by MARIE SKŁODOWSKA-CURIE ACTIONS Individual fellowships (IF)H2020-MSCA-IF-2017. ProjectGSAS (794040)

Notes:

DNA tools for potato breeding

Development of a new variety is a 12 year process

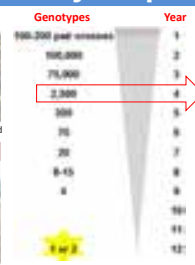
Year 1: 200 pair crosses



Parental selection — True Potato seed

Year 2: 100,000 Seedlings

Tuber from each seedling selected



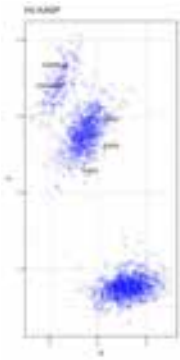
Marker Assisted Selection
for disease resistance

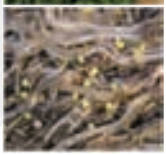
Years 3-12: Field evaluations

- Yearly increase in phenotyping effort as numbers are cut
- Over 50 traits assessed
- Advanced stage trials in the UK & Ireland and the Mediterranean

Using Marker Assisted Selection

- **Using DNA technology we can test for the presence of specific letters at a precise site in the genome**
- **These "molecular markers" are diagnostic for the presence of disease resistance genes in breeding lines**





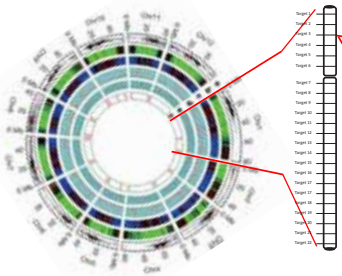
Notes:

PotatoMASH
DNA fingerprinting tool

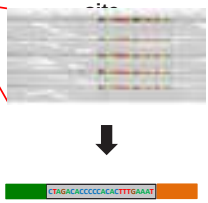
Why this project

We want to scan DNA variation across the potato genome to dissect the genetic basis of important characteristics and use this information to breed better varieties

Scanning the potato DNA



2. Maximise variation at each site



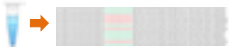
1. Scan variation at 400 sites evenly spaced across the genome

3. Add barcodes for multiplexing

Thousands of plants in one run

1. PCR to amplify 400 sites from the DNA of each plant

2. Sequencing all plants in one tube



3. Use barcodes to track each sequence for each plant

4. Cost effective: as low as €4 per plant

Impact on Breeding

- Precision breeding using genomics
- Potentially reduce ten year breeding cycle
- A single genomics tool to select for all important characteristics

This action is supported by a Marie Skłodowska-Curie Individual Fellowship MSCA-IF-EF-ST 797162

Notes:

Potato breeding

How is Potato Breeding Carried Out?


1. Selection of Parents

2. Fertilization

3. True Potato Seed


4. Young Seedlings

5. Evaluation Trials

6. New Variety

- Teagasc has been breeding potato since 1962
- To date, Teagasc has bred 45 varieties that have been marketed in more than 45 countries

IPM POTATO GROUP

Notes:

Potato breeding

How long does it take?

Where do we trial?

What traits are we improving?

- Yield & Adaptation
- Disease resistance
- Cooking quality
- Fry colour

IPM POTATO GROUP

Notes:

Rooster Why it's the nations favourite

For Producers

- Suited to Irish Conditions
- High yield for growers
- Excellent all year storage
- Good disease resistance

For Consumers

- Distinctive red skin
- Excellent taste and texture
- Superb versatility, boil, mash, roast, wedges, chips
- Shallow eyes and uniform shape
- Unique and recognisable name

Where did Rooster get its name?

"The story goes that a grower once gave a woman some red skin potatoes left over from a trial. She came back for more and asked what their name was. He hesitated, looked out the window and saw a rooster and just said the first thing that came into his mind. The name stuck!" Harry Kehoe, Potato Breeder

IPM POTATO GROUP

Notes:

Bred in Carlow by Teagasc
Marketed Worldwide by IPM Potato Group

Irish bred potatoes grown on every continent

Potatoes have names too


Nectar


Tornado


Electra

IPM POTATO GROUP

Notes:

How do you like your spuds?

Crisps and chips

- Irish consumer likes a light yellow colour
- Industry wants potatoes that will provide this after many months in storage

Waxy or Floury?

We evaluate

- Taste
- Structure
- Colour
- Blackening
- Mealiness
- Dry Matter

What determines crisp and chip colour?

- Storage at low temperature causes starch to break down into sugar
- High sugar levels => dark fry colour
- Resistance to **"low temperature sweetening"** is an important trait

IPM POTATO GROUP

Notes:

BETTER farm crops programme

Better farm programme

Focus on Precision Farming

"How to achieve maximum field performance through Smart farming"

John Collins - Waterford

Kevin Nolan - Carlow

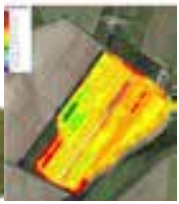
Derek Keeling - Dublin

Universal precision tools

- Develop a toolkit to identify and manage soil variation
- Focus on soil characteristics and nutrition
- Role of organic manures & catch crops
- Measure performance against crop benchmarks

Hi-tech precision tools

- Use of specialist tools to aid decisions
- Role of hi-tech precision equipment
- Focus on crop recording and record keeping
- Evaluate new technologies on farm



Notes:

BETTER farm
crops programme

Farm planning is Key to precision

Costs per ha
Margin per ha
Yields per ha
Fertilizer Records
Machinery costs per ha.

Costs per tonne
Fertiliser plan
Machinery plan

E-profit monitor
Financial a/c's
NMP online
Machinery costs calculator
Soil tests

Machinery costs
Better Farm Average
€315/ha
National Average
€335/ha

Every €100,000 spent on machinery adds
€20-30/ha
on machinery costs

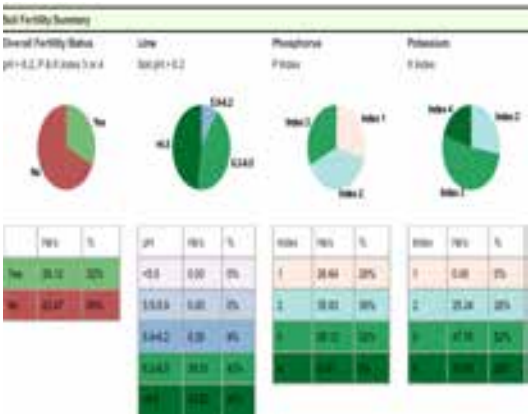
Notes:

BETTER farm crops programme

NMP online – fertiliser planning

Know your Soil Fertility
- pH and lime requirement
- Soil P
- Soil K
- Overall Fertility

NMP Online Fertiliser Plan Combining
- Teagasc Recommendations
- Nutrient advice maps
- Nitrates Limits



Soil pH and Lime Map

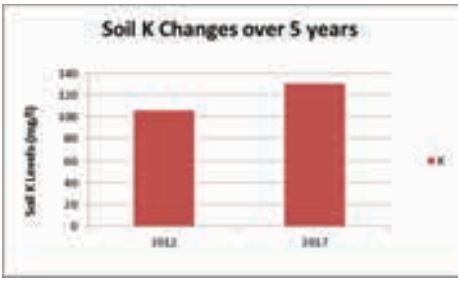
Soil P Index Map

Plan your Lime & Fertiliser to
- Build soil fertility
- Increase fertiliser efficiency
- Maximise crop yields

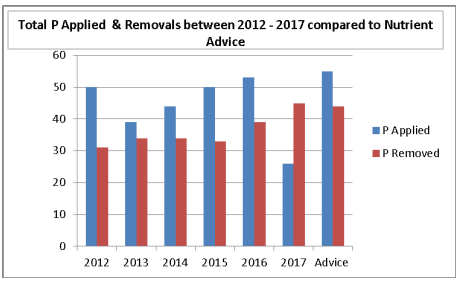
Notes:

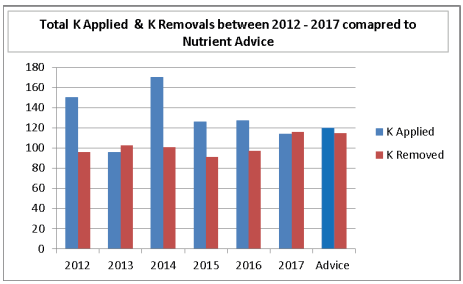
Soil and nutrient use

Farm Soil Fertility Changes 2013 to 2017



Farm P & K Balances between 2012 to 2017





Waterford Better Farm

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