

# Teagasc Grass and Clover Breeding Programme

Patrick Conaghan

Grassland Science Department,  
Animal & Grassland Research & Innovation Centre,  
Teagasc, Oakpark, Carlow.



AGRICULTURE AND FOOD DEVELOPMENT AUTHORITY

# Variety Improvement

15 to 20 year process consisting of 3 stages

## Stage 1

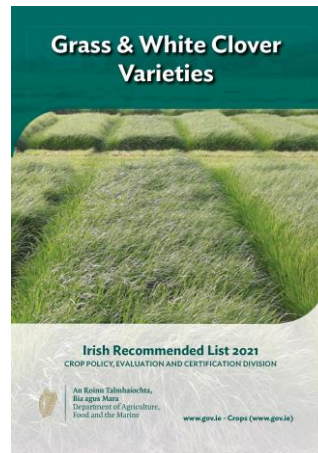
**Breeding**  
(product development)  
7 to 10 years



**Teagasc**

## Stage 2

**Independent  
variety testing**  
(product testing)  
5 to 7 years



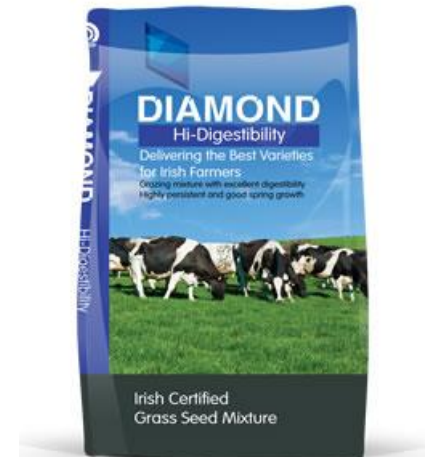
**Dept. of Agriculture,  
Food & Marine**

+

**Teagasc**

## Stage 3

**Commercialisation**  
(product release)  
≥ 2 years



**Goldcrop**

# What is Plant Breeding?

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**Definition:** Human directed evolution

**Evolution:** The genetic change in a species over time



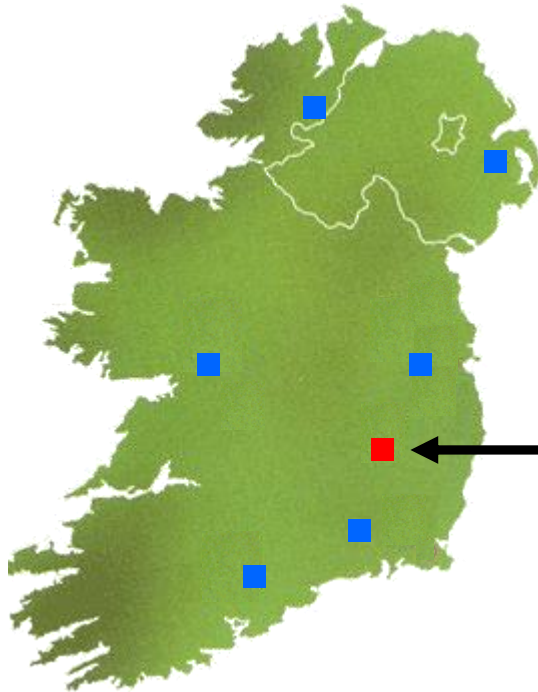
- Natural & ongoing process
- Slow
- Direction of evolution favoured by man & nature may be different

## **Breeding is necessary:**

- To speed up the process of evolution
- To ensure evolution proceeds in a direction favourable to man's needs
- Production environment is constantly changing - climate, pests, diseases, new regulations
- Cost effective - UK £1 invested in wheat & barley breeding returns £40 to economy

# Teagasc Breeding Station

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**Teagasc Breeding Station**  
**Oak Park, Carlow**  
**225 ha research farm**

- Official Dept. of Agriculture, Food & Marine (Ireland) and Agri-Food & Biosciences Institute (Northern Ireland) variety evaluation sites

# Milestones

1960

## Start-up

### Primary focus:

Research on breeding methods + variety evaluation

### Secondary focus:

Breeding commercial varieties

1980

First perennial ryegrass variety:

*Greenisle*



1983

First white clover variety:

*Aran*



1985

## Change-up

### Primary focus:

Breeding commercial varieties

### Secondary focus:

Research on breeding methods

### Dept. of Agriculture:

Variety evaluation

2002

New molecular genetics programme established



2013

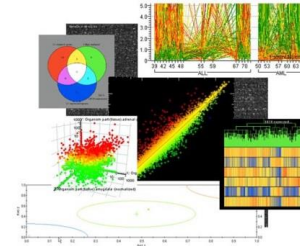
New commercial partner:

*Goldcrop*



2017

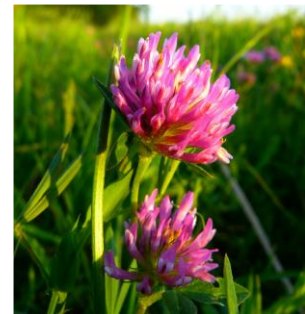
First perennial ryegrass variety developed by genomic selection



2023

First red clover variety:

*Fearga*



# Objectives

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**Mission:** To support sustainable & profitable animal production from grassland in Ireland by breeding improved varieties for Irish farm systems

**Target:** Sufficient yield of quality forage to meet the animal feed demand curve over the entire season plus provision of adequate winter feed as silage

**Species:**



**Perennial ryegrass**

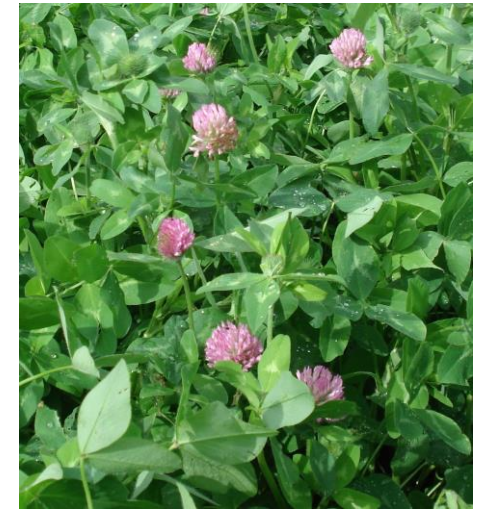
*Diploid + tetraploid*

*Intermediate + late heading*



**White clover**

*Small, medium + large leaf size*



**Red clover**

*Diploid*

# Traits for Improvement

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- **Forage yield** → Spring, summer, autumn, silage + annual production
- **Quality** → Digestibility, leafiness, graze out, disease resistance
- **Persistency** → Changing ground cover + yield over time, grazing resilience, disease resistance
- **Sustainability** → Nitrogen use efficiency, N fixation, clover content



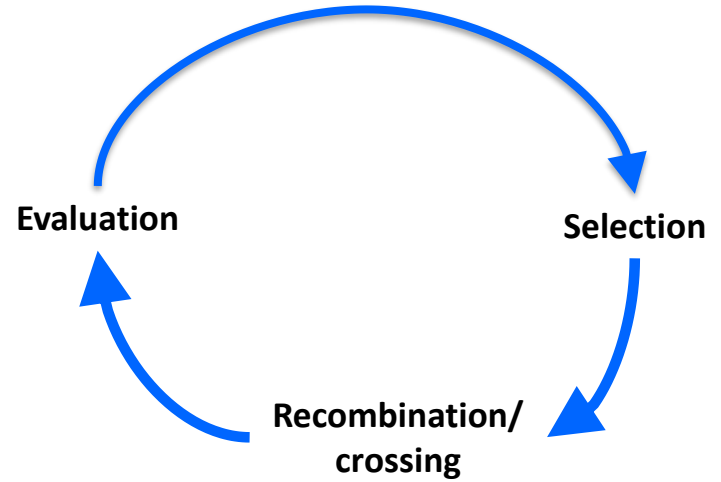
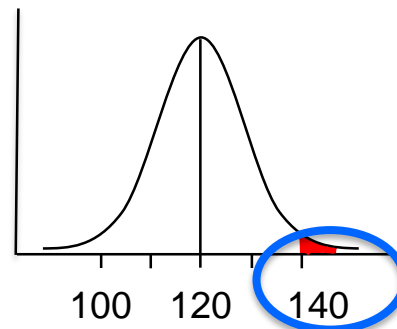
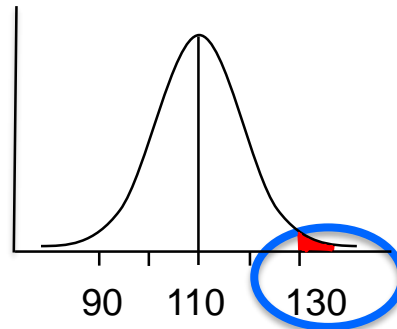
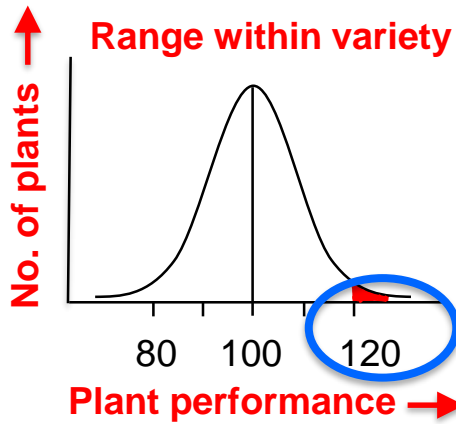
# Breeding Process



Every seed & every plant is unique



Genetics & performance





# Evaluation



**X**

**X**

Locations

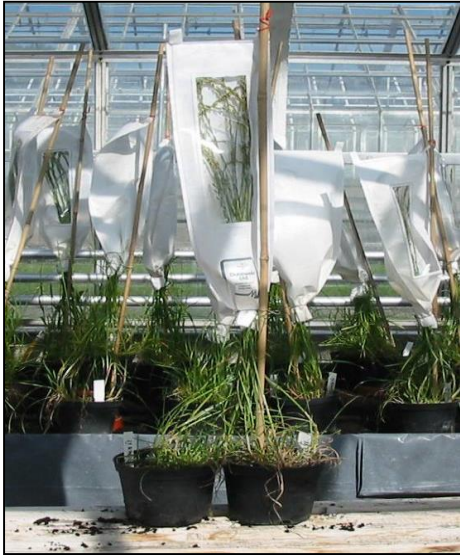
**X**

Years

# Recombination: Perennial Ryegrass

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Wind pollinated





# Recombination: Clover

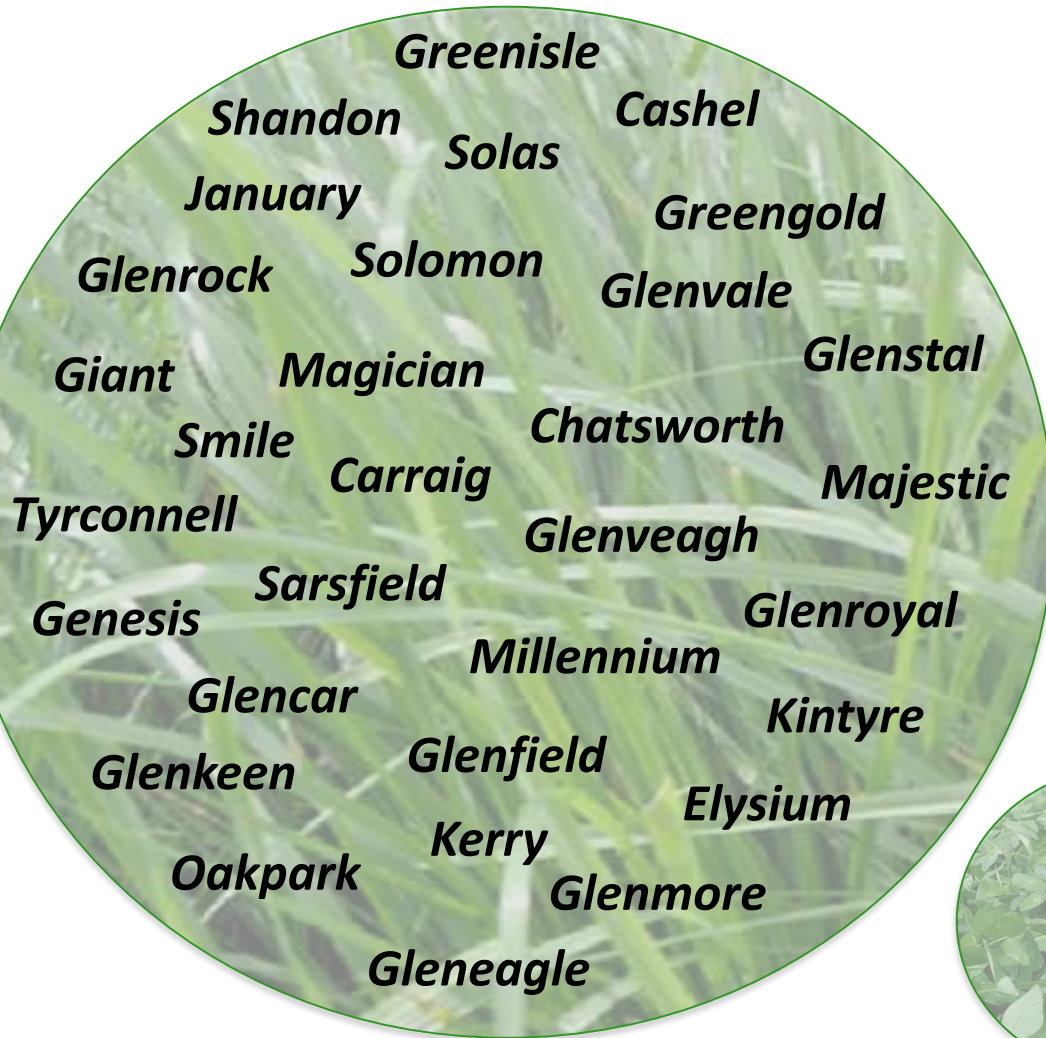
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Insect pollinated



# Varieties

1.1 new varieties per year since 1985



31 perennial ryegrass



11 white clover

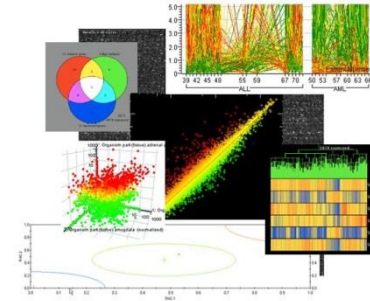


1 red clover

# Genetic Gain

## Q. Genetic gain to present?

- Annual yield 4 to 6 % per decade
- Digestibility 1% per decade



## Q. Future genetic gain?

- New technologies → molecular breeding, optical sensors, machine learning
- 2 to 3 fold higher genetic gain

## Q. Limits to genetic gain?

Cultivated grain crops markedly different from wild relatives



**Wheat  
wild relative**



**Maize  
wild relative**

- Wild vs. cultivated forage grasses morphologically similar
- Forage breeding still in it's infancy → huge potential remains

# Future View



Year 2040

Sustainability, climate change, environmental footprint, biodiversity, wildlife habitat, animal health & welfare, food quality



## Grasses

## Legumes

## Herbs

*Primary*

**Perennial ryegrass**

**White clover**

**Chicory/plantain**

Diploid

Tetraploid

*Secondary*

?

**Red clover**

**Tertiary**

?

?

?

**Potential as future main or companion species?**

Italian ryegrass  
Hybrid ryegrass  
Timothy  
Tall fescue  
Festulolium  
Yorkshire fog  
Cocksfoot

Sainfoin  
Birdsfoot trefoil  
Lotus  
Kura clover  
Lucerne/alfalfa

Yarrow  
Sheep's parsley  
Burnet

# Conclusions

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- The Teagasc forage breeding programme continues to develop improved varieties of grass & clover for Irish farm systems ✓
- Introduction of new technology, including genomic selection, will significantly accelerate genetic gain ✓
- No evidence that we are approaching limits to genetic progress ✓
- The future is in our hands ✓





# Acknowledgements

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- **Support of all present and past forage breeding staff:**

*Vincent Connolly, Pat Murphy, John Teehan, Olivia Aylesbury, Henry O'Shea, Pat Deegan, Paddy Kavanagh, John Hogan, Mick Murphy, Tom Ralph, Mary O'Sullivan, Jean Enjelvin, Alan Hendy, Fergus Meade, Damian Brennan and Michael Osbourne*

- **Commercial partners:**

