



Wheat variety blends; genetic, agronomy and supply chain considerations

Aoife O' Driscoll

17th October 2023

Variety blends have a long history in the UK

- Sinclair McGill researched and commercialised blends in the '70s
- World record achieved in 1994 with wheat and barley blends

THE GUINNESS BOOK OF RECORDS 1994

Crop Production

Barley The total amount of land farmed for barley production in the 1990/91 season was estimated to be 75.2 million ha, 10 million acres, with total production of 181.5 million tonnes and an average yield of 2.40 tonnes/ha. The world's leading grower of barley is the former USSR, which is estimated to produce 57 million tonnes from about 26 million ha (64.2 million acres).

A yield of 12.2 tonnes/ha of winter barley was achieved on 2 Aug 1989 by Gordon Bennie of Edington Mains, Burnside, Borders from 21.29 ha (52.6 acres).

The total area of land used for growing cereals in 1990/91 was 128.1 million ha (316.8 million acres), producing 472 million tonnes, 60 million tonnes of which were produced by China from an estimated 21 million ha (52.9 million acres).

Oats The world-wide production of oats in 1990/91 was an estimated 326 million tonnes harvested from about 21.4 million ha (53.4 million acres), most of which, 17.5 million tonnes, is produced by the former USSR from some 10.5 million ha (26 million acres).

Potatoes Norfolk farmer Roger Southwell harvested 205.65 tonnes of potatoes in four rows from an area of 2.46 ha (6.07 acres) at Watermill Farm, Southwell, Norfolk on 1 Nov 1989. The machinery used was made by Glendon Engineering Ltd of Dy Cambs.

Rice About half of the world's population, including virtually the whole of East Asia, totally dependent on rice as the staple food. The total amount of land used for rice production is 141.8 million ha (352.7 million acres), with India leading on the area farmed, at 42.2 million ha (104.5 million acres). The world's leading producer however is China, with estimated yields of 105 million tonnes from 32.5 million ha (80.8 million acres).

Wheat An estimated 230.5 million ha (569 million acres) of land is used for wheat production world-wide, giving a yield of 800 million tonnes. The leading grower is the former USSR, which produces 160 million tonnes from about 67.5 million ha (167.4 million acres) (approx).

The largest single fenced field sown with wheat measured 14100 ha, 35000 acres and was sown in 1951 south-west of Lethbridge, Alberta, Canada. The British record yield is 13.99 tonnes/ha (111.4 cwt/acre) from 17.49 ha (43.2 acres) by Gordon Bennie of Clifton Mains, Newbridge, Lothian in 1981.

Wheat Largest rick: A rick of 40 400 bales of straw was built between 22 Jul and 3 Sep 1982 by Nick and Tom Fanson with a gang of eight at Cuckoo Pen Barn Farm, Bridg, Glos. The completed rick measured 45.7x9.1x18.2m (150x30x60) high and weighed some 711 tonnes. The straw baled, loaded and ricked 24 200 bales in seven consecutive days from 22-29 July.

Wheat Speed: Erik Klemmensen of Trøstrup, Djursland, Denmark baled 200 tonnes of straw in the 54 min using a Hesston 4600 baling machine on 30 Aug 1989.

Combine harvesting Philip Baker of West End Farm, Milton, Somerset, Great Britain harvested 305 tonnes of wheat in eight hours using a Massey Ferguson MF 55 combine on 8 Aug 1989.

On 9 Aug 1990 an international team from CWS Agriculture, led by estate manager Ian Hargitt, harvested 358.0 tonnes of wheat in eight hours from 44 ha (108.7 acres) at Cockayne Hatley Estate, Sandy, Beds. The equipment consisted of a Claas Combi 228 combine fitted with a 5000 Series Reynolds SR 5000 stripper head.

Ploughing The world championship (inaugurated 1954) has been staged in 18 countries and won by competitors from 14 countries. The current champion has been the most successful country, who had to champion. The only person to take the title three times is Hugh B. Dale of Northern Ireland, in 1954, 65, and the bronze-recovered title for ploughing, before in 1964 to United Kingdom. The title of Ploughing rules is 5.5m (18ft) for the Joe Langley at Humber Hill Farm, Wougham, Norfolk, Gambia on 21 Oct 1987. He used a Case IH 7140 Mighty tractor and Kverneland four-furrow plough.

The victory was achieved with a maximum depth of 42.8 cm (16.9 in) on 29 Nov 87. The 72-acre plot was ploughed to record standard and Peter Young of Wiltshire Young Farmers used a Case IH tractor and Kverneland plough, at Marley Farm, Pewsey, Wiltshire on 20 Sep 1988.

Barley is just one of the cereal crops grown in record amounts in the republics of the former USSR, which together produce an estimated 57 million tonnes from an area of about 26 million ha (64.2 million acres). (Photo: Images Colour Library)

Comet winter wheat blend 1990

The benefits of blends

Higher Yields
Since field scale trials began in 1974, winter wheat blends have considerably out-yielded the mean of the components by an average 3%.

Reduced Disease Pressure
Disease control is vital in the profitable production of wheat. The practice of varietal diversification is particularly important in light of the recent increases in the potential levels of yellow rust infection that wheat crops face. Blends delay the rate at which yellow rust spreads through the crop, giving you valuable time to spray high risk straight varieties first.

Sixteen years of 'farm experience' have shown that blends have several additional benefits.

Compensation for stress - if one variety suffers e.g., a cold spring and drought conditions the other two components 'fill in'.

Leaf canopy - blends improve the leaf canopy, making better use of available light.

Efficiency - blends start working the minute they emerge and continue to do so right up to harvest.

1990 Comet wheat blend

Beaver, Riband, Galahad
A soft endospermed blend of three excellent winter wheats, enhancing each other to produce a highly profitable combination.

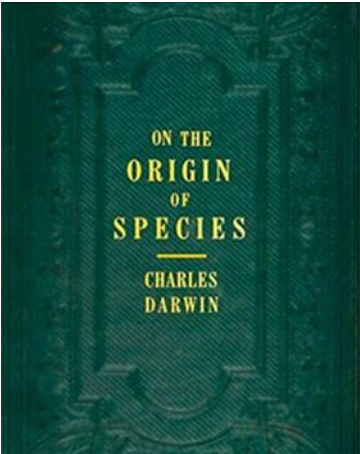
Grain quality
All three varieties are soft endospermed with an identical NIAB score for specific weight - 75.5 kg/hl.

Comet will be highly acceptable to the feed compounder and may be bought for the biscuit/soft milling marketing.

AGRONOMIC CHARACTERS			
	BEAVER	RIBAND	GALAHAD
STANDING POWER	7	9	5
SHORTNESS OF STRAW	8	7	7
EARLINESS OF RIPENING	6	7	8
RESISTANCE TO MILDEW	8	7	7
YELLOW RUST	3	4	4
BROWN RUST	4	4	3
EYESPOT	4	6	5
S. NODORUM	6	5	6
S. TRITICI	5	3	6

Comet blend yield data England and Wales

Blend	Treated (%)	Mean (%)	Untreated (%)
BEAVER	140	130	120
RIBAND	135	125	115
GALAHAD	125	115	105
COMET	135	125	115



Variety mixtures discussed by Darwin in 'On the Origin of Species'

"It has been experimentally proved, that if a plot of ground be sown with one species of grass, and a similar plot be sown with several distinct genera of grasses, a greater number of plants and a greater weight of dry herbage can be raised in the latter than in the former case. The same has been found to hold good when one variety and several mixed varieties of wheat have been sown on equal spaces of ground" (Darwin, 1859)



ELSEVIER

Crop Protection

journal homepage: www.elsevier.com/locate/cropro

Mixtures of UK Wheat as an Efficient and Environmentally Friendly Source of Genetic Diversity

J. Stuart Swanston , Adrian C. Newton

First published: 08 February 2008 | <https://doi.org/10.1016/j.cropro.2008.02.001>

Increased yield stability of field-grown winter barley (*Hordeum vulgare* L.) varietal mixtures through ecological processes

Henry E. Creissen ^{a, b, 1}, Tove H. Jorgensen ^{b, c}, James K.M. Brown ^{a, *}

Journal of Brewing
The Institute of Brewing

100+ research papers on wheat and barley variety blends under UK agronomic conditions

populations in the UK: selected results

Malting Performance of Barley Cultivar Mixtures from the UK and Poland

J. S. Swanston, A. C. Newton, D. C. Guy, E. S. Gacek

First published: 16 May 2012 | <https://doi.org/10.1002/j.2050-0416.2000.tb00063.x> | Citations: 10

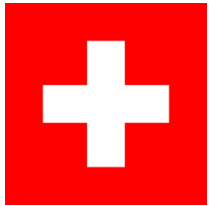
...ies², Sally Howlett¹, Helen Pearce¹, Louisa
stead Marshall, Newbury Berks RG20 0HR, UK.
ights, Reading, Berks., UK.
wakelyns.co.uk

ulations

Today-international markets



Approx 40% of winter wheat market



Three wheat blends commercially available with approx 7% of market.



18% of bread wheat area, 4.4% of durum wheat, 5% of barley, 15% of triticale

*Figures do not take into account home saved seed

Data Sources: Aarhus University, InraE, Agroscope



Challenges

Knowledge exchange and data interpretation

- What makes a good variety blend?
- Does diverse parentage really matter?
- The differences between a population and a variety blend

Regulatory and commercial

- Wheat supply chains built around the traceability and provenance of uniform varieties.
- Blends are attractive to growers but disruptive to the rest of the supply chain
- Managing farm-saved seed payments
- Will grain buyers accept the end-product? Are end markets restricted to feed and fuel?

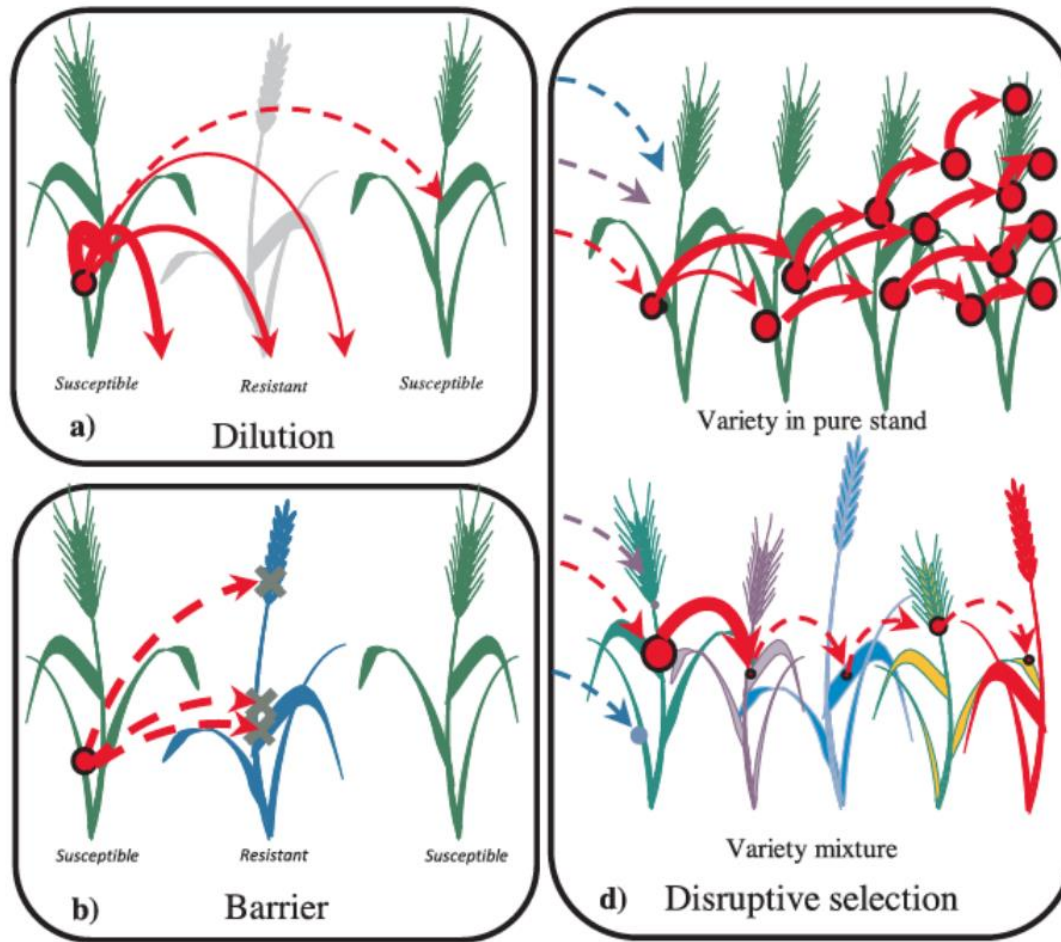


Questions around disease management

- What happens to diseases in a blend?
- How do you time fungicide inputs?
- Can you reduce fungicide spend by growing a blend?
- Can you increase yields by growing a blend and using the same level of inputs?



What happens to disease in a blend?



*



A typical wheat field can carry ca. 3 million *Z. tritici* genotypes/ha

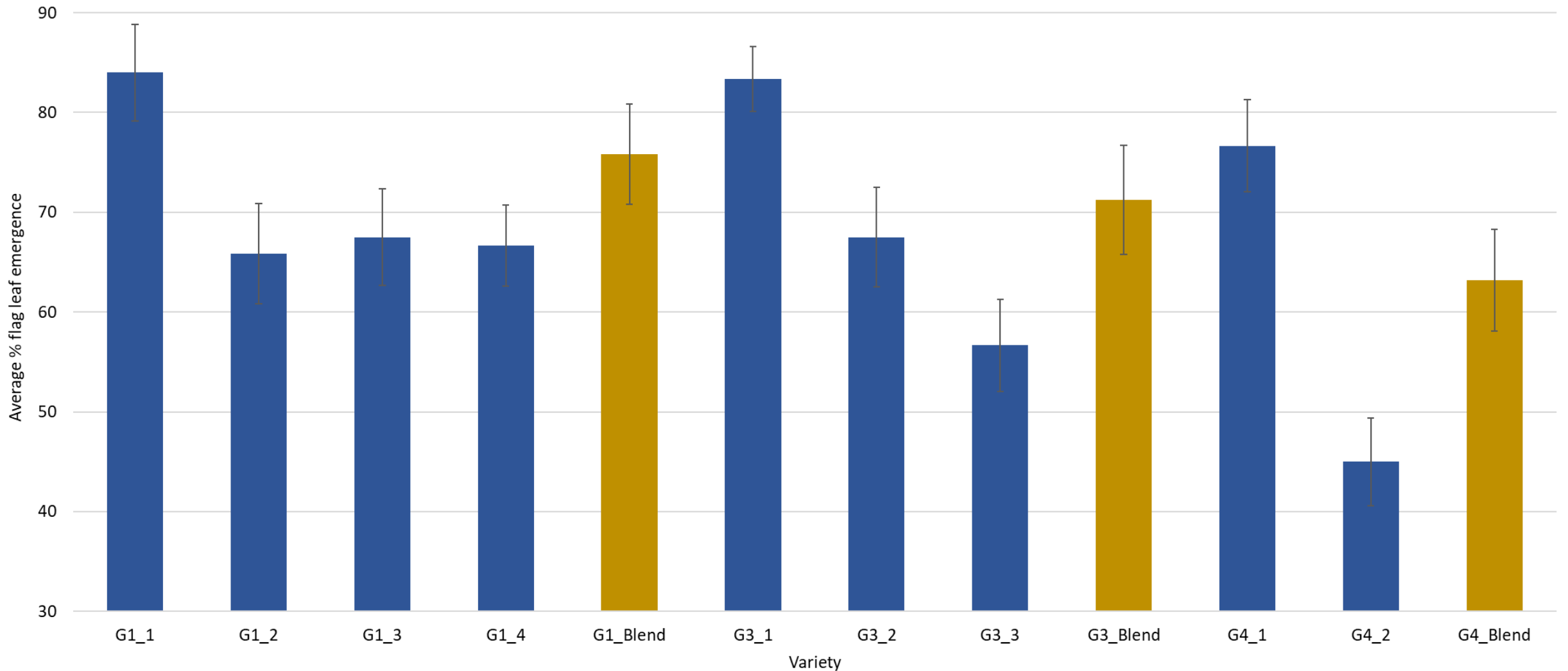
Produce ca. 2 trillion pycnidiospores/ha**

*Kristoffersen, R., et al., Management of Septoria tritici blotch using cultivar blends. Plant Disease, 2022

**McDonald et al. How large and diverse are field populations of fungal plant pathogens? The case of *Zymoseptoria tritici*. Evol Appl. 2022



Leaf layer emergence and fungicide timing

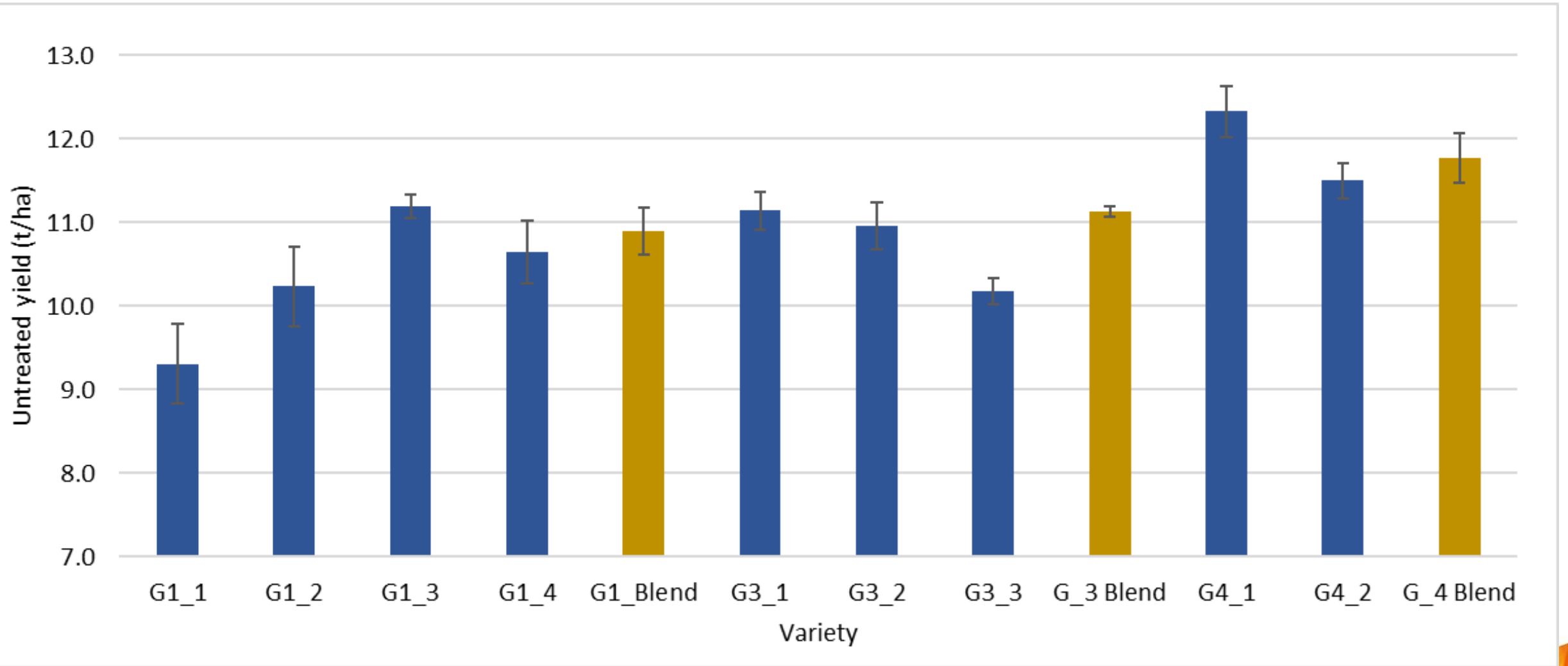


Questions around disease management

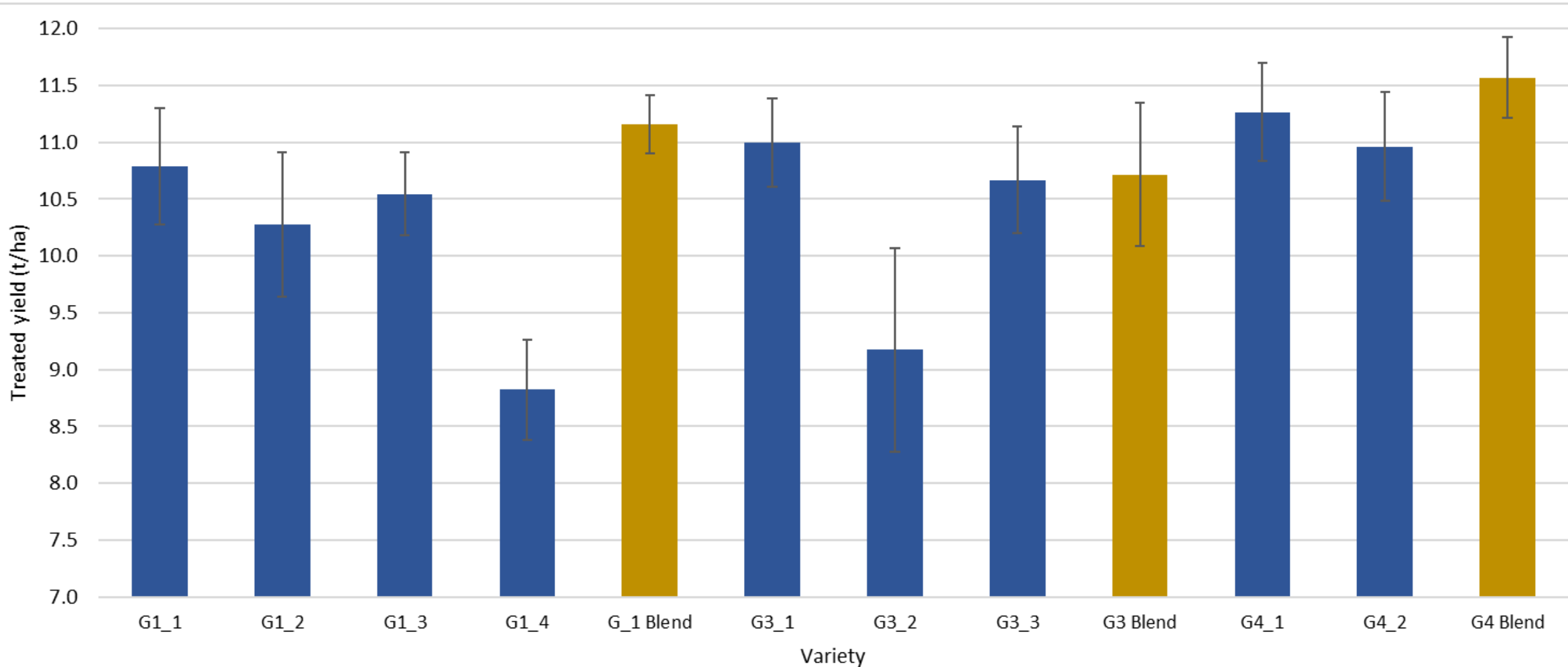
- What happens to diseases in a blend?
- How do you time fungicide inputs?
- Can you reduce fungicide spend by growing a blend?
- Can you increase yields by growing a blend and using the same level of inputs?



2022 untreated yields



2022 treated yields





KWS Zyatt untreated



KWS Zyatt full fungicide programme

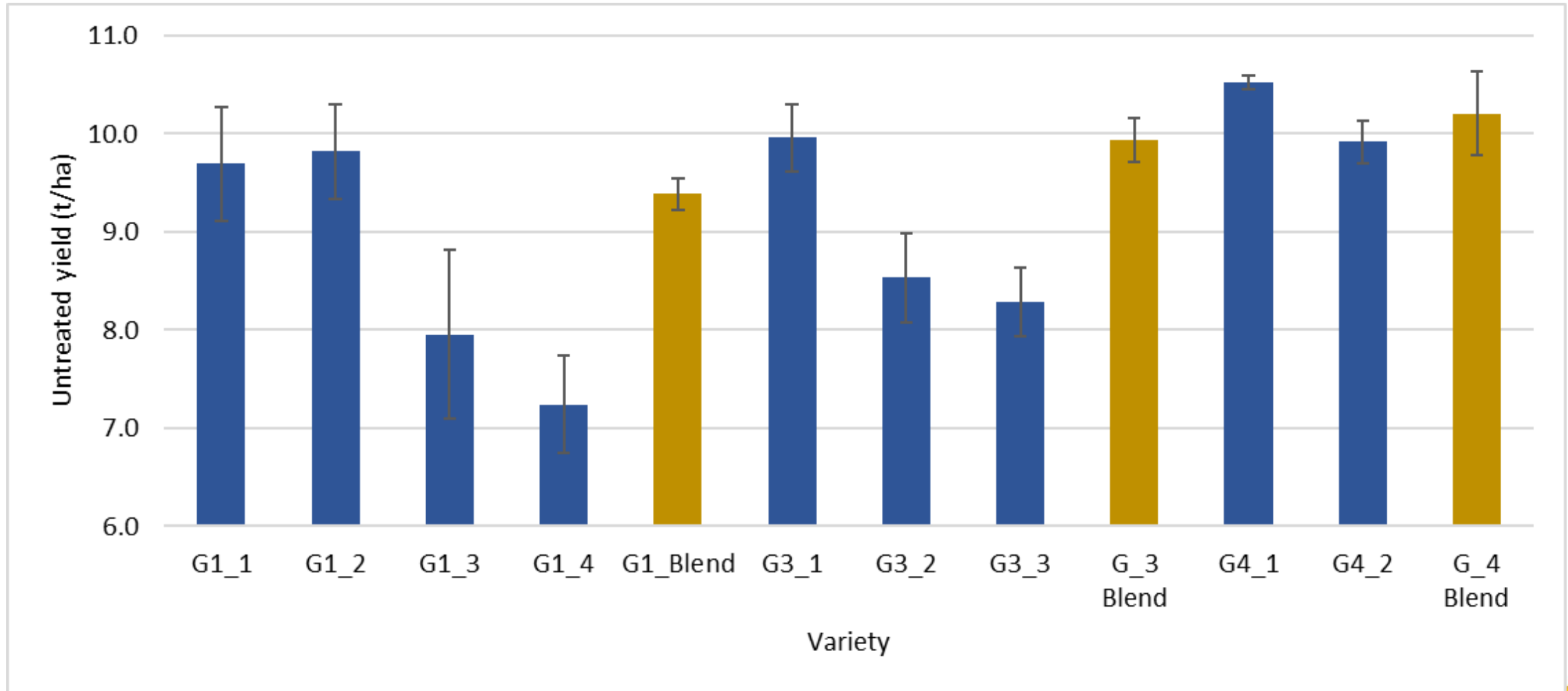


KWS Zyatt in 4-way mix. Reduced rate program

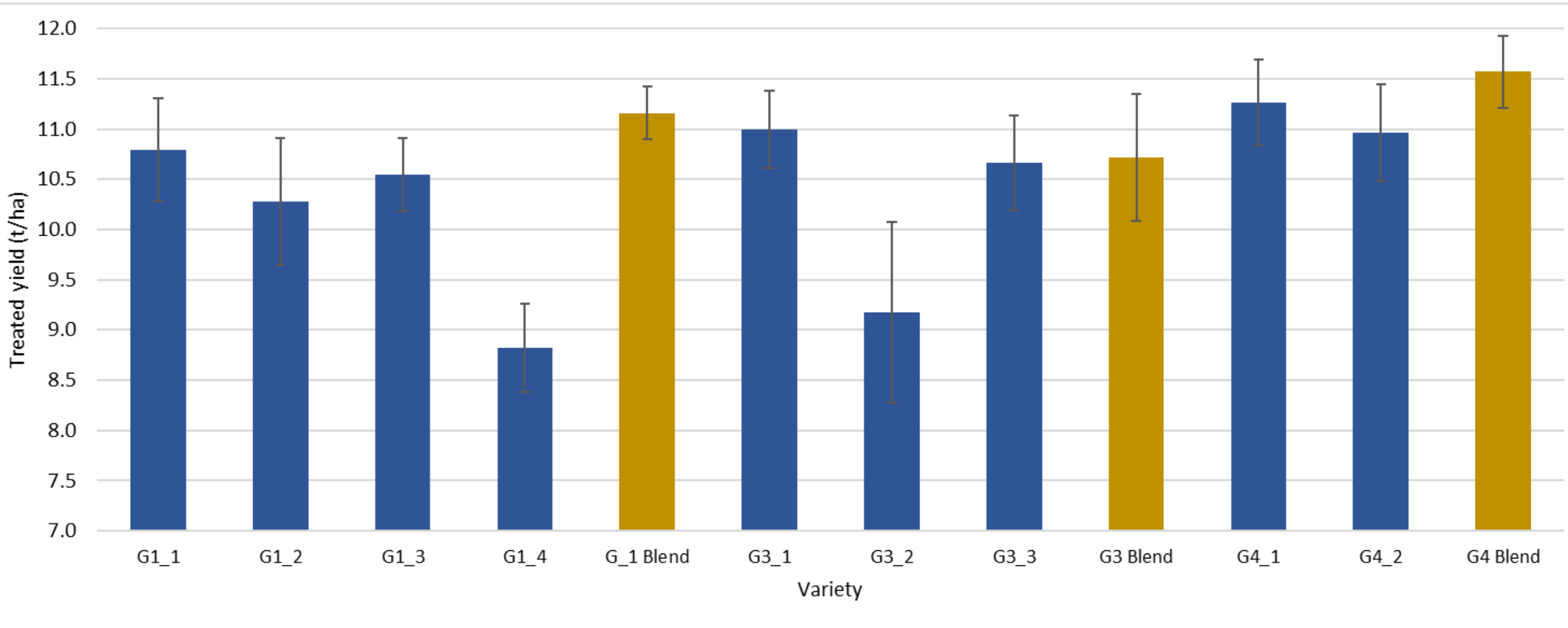


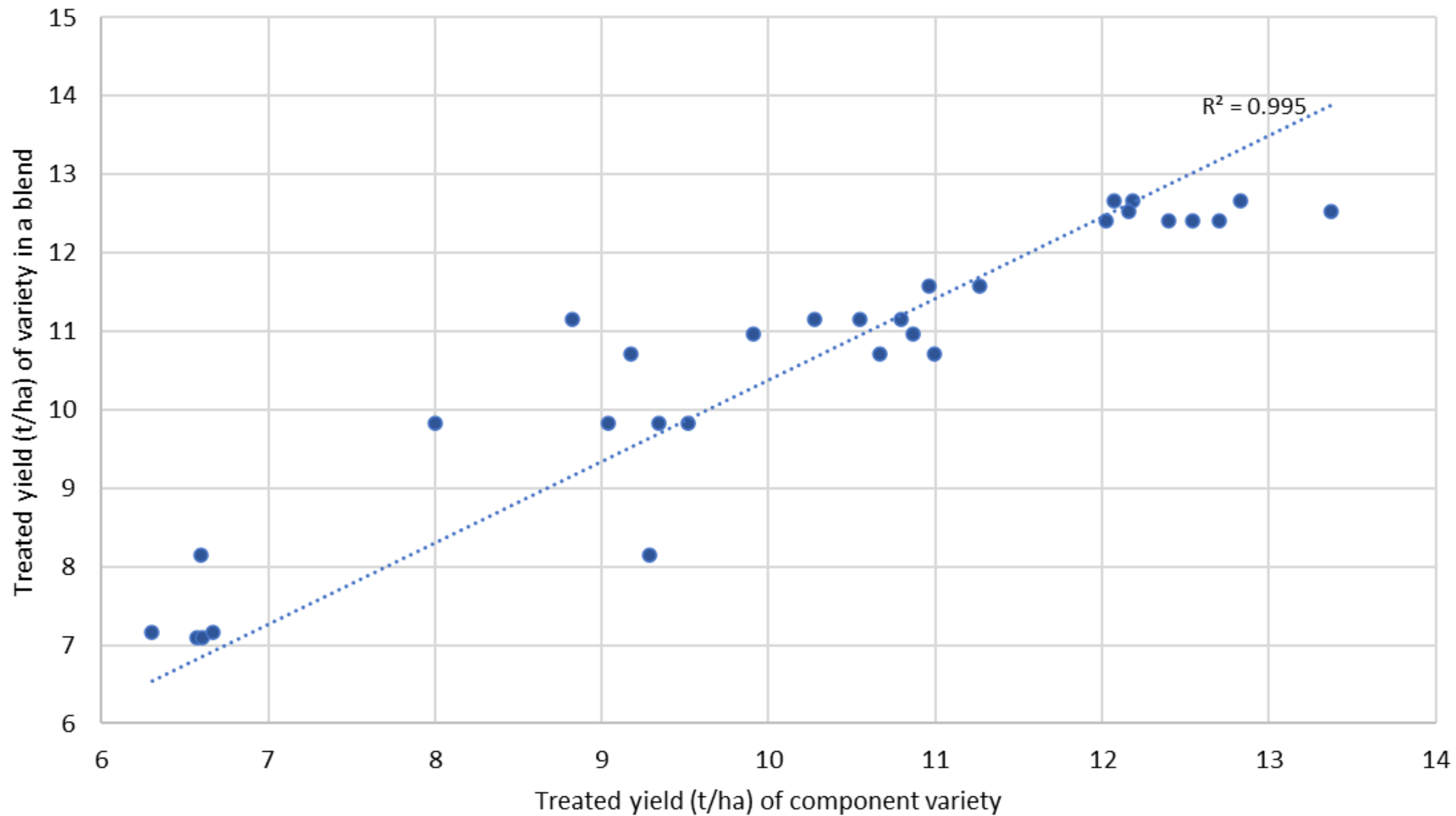
KWS Zyatt in 4-way blend. Untreated

2023 untreated yields



2023 treated yields





Knowledge exchange and data interpretation

- What makes a good variety blend?
- Does diverse parentage really matter?
- What are the differences between populations and variety blends?

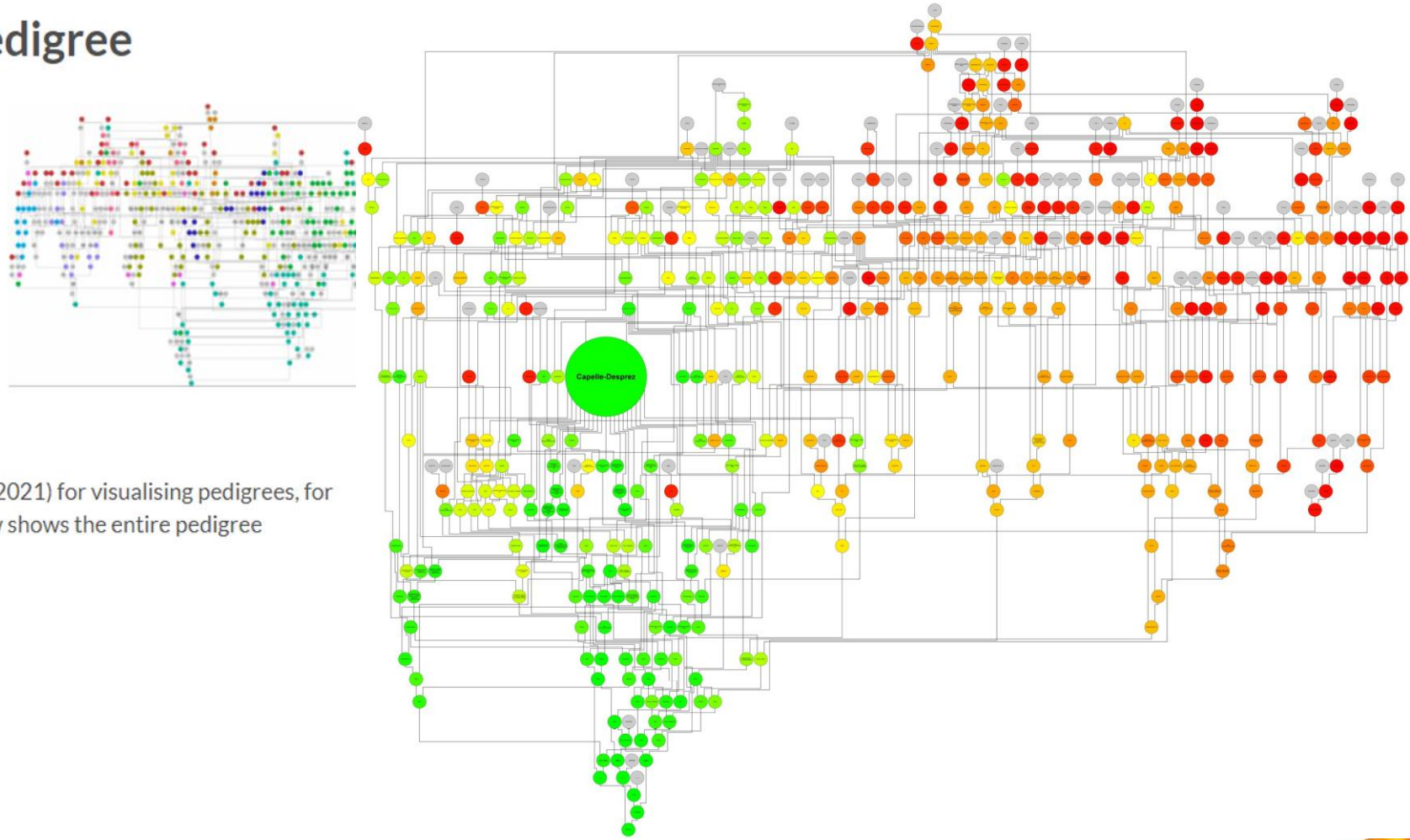


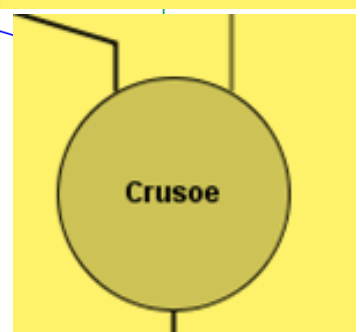
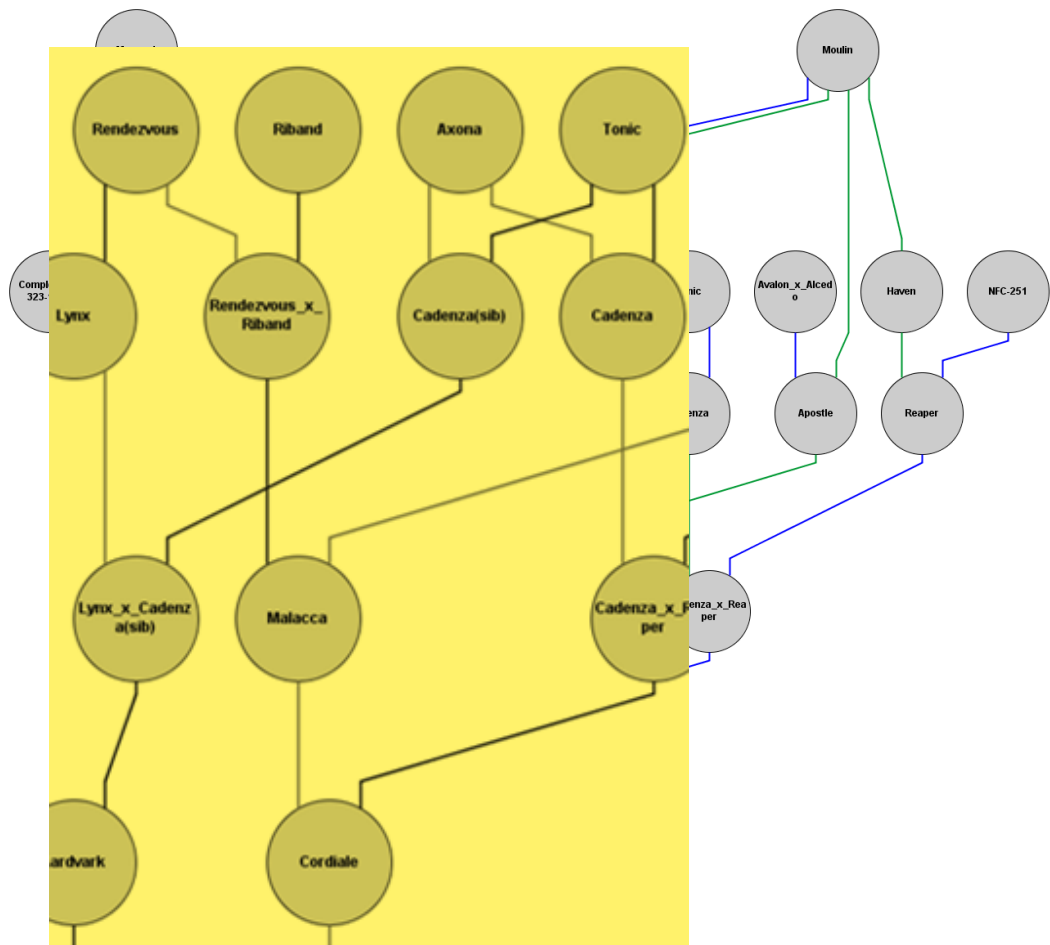
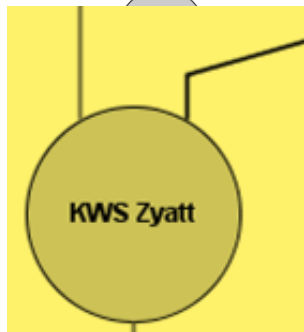
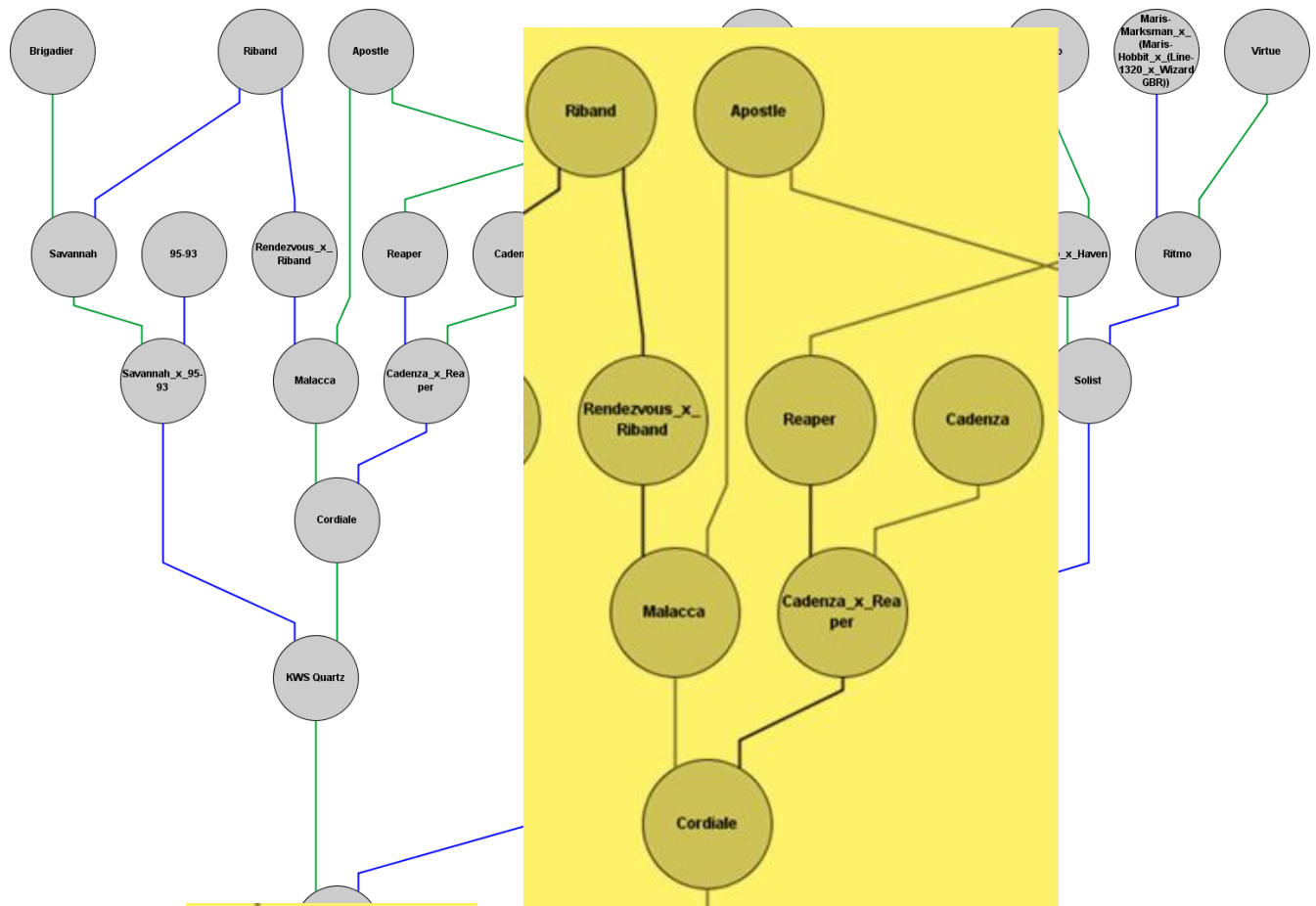
UK wheat varieties pedigree

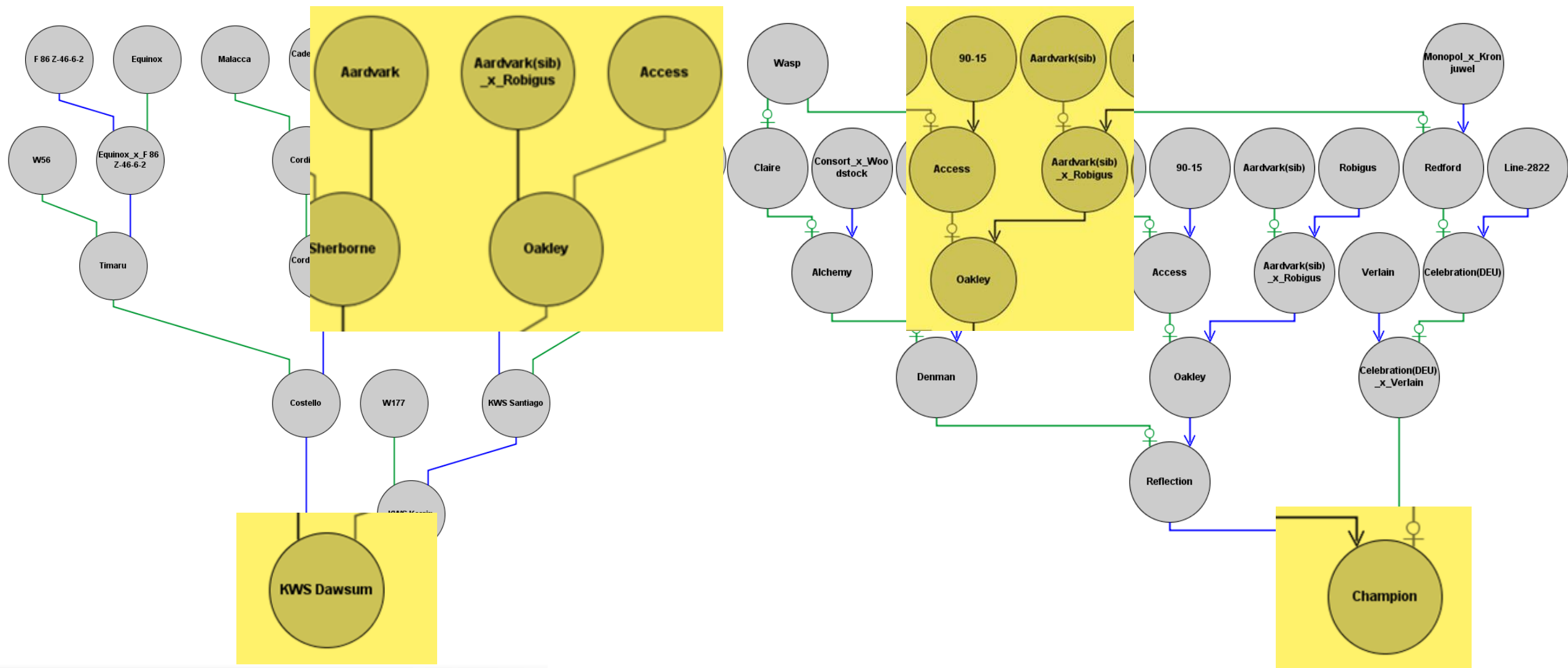
For further information contact: Dr James Cockram or Nick Fradgley

The wheat pedigree provides information on parentage, country of origin, year of use and breeding company for an extensive set of UK wheat varieties. The pedigree is updated each year with new AHDB Recommended List varieties and we would welcome suggested edits and additions.

Download the latest [input files](#) (December 2021) for visualising pedigrees, for use with [Helium software](#) - the image below shows the entire pedigree







Challenges and opportunities

- Blends threaten to disrupt established supply chain models in breeding, agronomy, seed certification, grain processing
- An *opportunity* for the whole supply chain to consider different approaches.
- Large mills require consistent performance enabling lower cost of production.
- *Opportunities* for smaller mills, using less automation but delivering higher value products
- Seed production; multi-component blends can be too costly to produce at scale.
- *Opportunities* for smaller seed companies to produce higher value, higher margin blends in volumes to serve specialist markets.
- Buy back contracts are available from a number of seed merchants





Thanks to:
NIAB Membership for trial and KE funding

NIAB colleagues:
Dr Phil Howell and Clare Leaman



Potential future work

- Performance in no till systems
 - Rooting depth, early vigour and resilience to drought
- Disease management
 - Dilution versus barrier effects
 - Changes in virulence and fungicide resistance
 - Agronomic strategies, timing and inputs
- Pest and weed management
 - Balancing crop competition effects with herbicide efficacy
 - Can blends confuse, attract or repel e.g. aphids?
- Larger questions around genetic drift, allelic and genotypic richness and population ecology

