Department of Primary Industries and Regional Development

GOVERNMENT OF WESTERN AUSTRALIA

Protect
Grow
Innovate

Wheat maturity classes and their use

Dion Nicol – Wheat Research Scientist, Merredin

Wheat maturity types

TABLE 13. Duration of days from sowing to flowering (relative to Scepter) at selected NVT and DPIRD trials in 2021

Variety	Maturity	Northern NVTs*	Southern NVTs*	Mullewa	Merredin	Katanning	Grass Patch	Average
Sowing date		**15-May**	**25-May**	**6-May**	**14-May**	**11-May**	**13-May**	
Emu Rock	Quick	-15	-6	-15	-	-9	-8	**-11**
LRPB Anvil CL Plus	Quick	-12	-6	-12	-8	-10	-9	**-10**
Vixen	Quick	-7	-7	-10	-6	-5	-4	**-7**
Sting	Quick	-5	-5	-10	-5	-5	-1	**-5**
Razor CL Plus	Quick–mid	-4	-4	-	-	-	-	**-4**
LRPB Havoc	Quick–mid	-3	-6	-	-	-	-	**-5**
Mace	Quick–mid	-1	-2	-	-	-	-	**-2**
Devil	Quick–mid	-1	0	-1	-1	1	1	**0**
Hammer CL Plus	Quick–mid	0	0	2	0	3	0	**1**
Calibre	Quick–mid	-3	-1	1	3	1	1	**0**
Scepter	Quick–mid	0	0	0	0	0	0	**0**
Chief CL Plus	Mid	1	2	4	2	4	1	**2**
Ninja	Mid	2	1	3	6	4	3	**3**
Sheriff CL Plus	Mid	4	4	-	-	-	-	**4**
Zen	Mid–slow	5	4	-	-	-	-	**5**
Magenta	Mid–slow	5	-	-	-	-	-	**5**
Brumby	Mid–slow	6	4	6	3	9	3	**5**
RockStar	Mid–slow	5	4	8	6	9	4	**6**
Kinsei	Mid–slow	8	6	10	7	11	7	**8**
Catapult	Mid–slow	9	6	10	4	10	3	**7**
Denison	Mid–slow	12	10	15	7	14	10	**11**
Valiant CL Plus	Mid–slow	13	10	-	-	-	-	**12**
Yitpi	Mid–slow	13	10	-	-	-	-	**12**
Cutlass	Mid–slow	13	9	11	8	12	11	**11**
Scepter's flowering date		**Av 26-Aug**	**Av 28 Sept**	**15-Aug**	**23-Aug**	**11-Sep**	**6-Sep**	

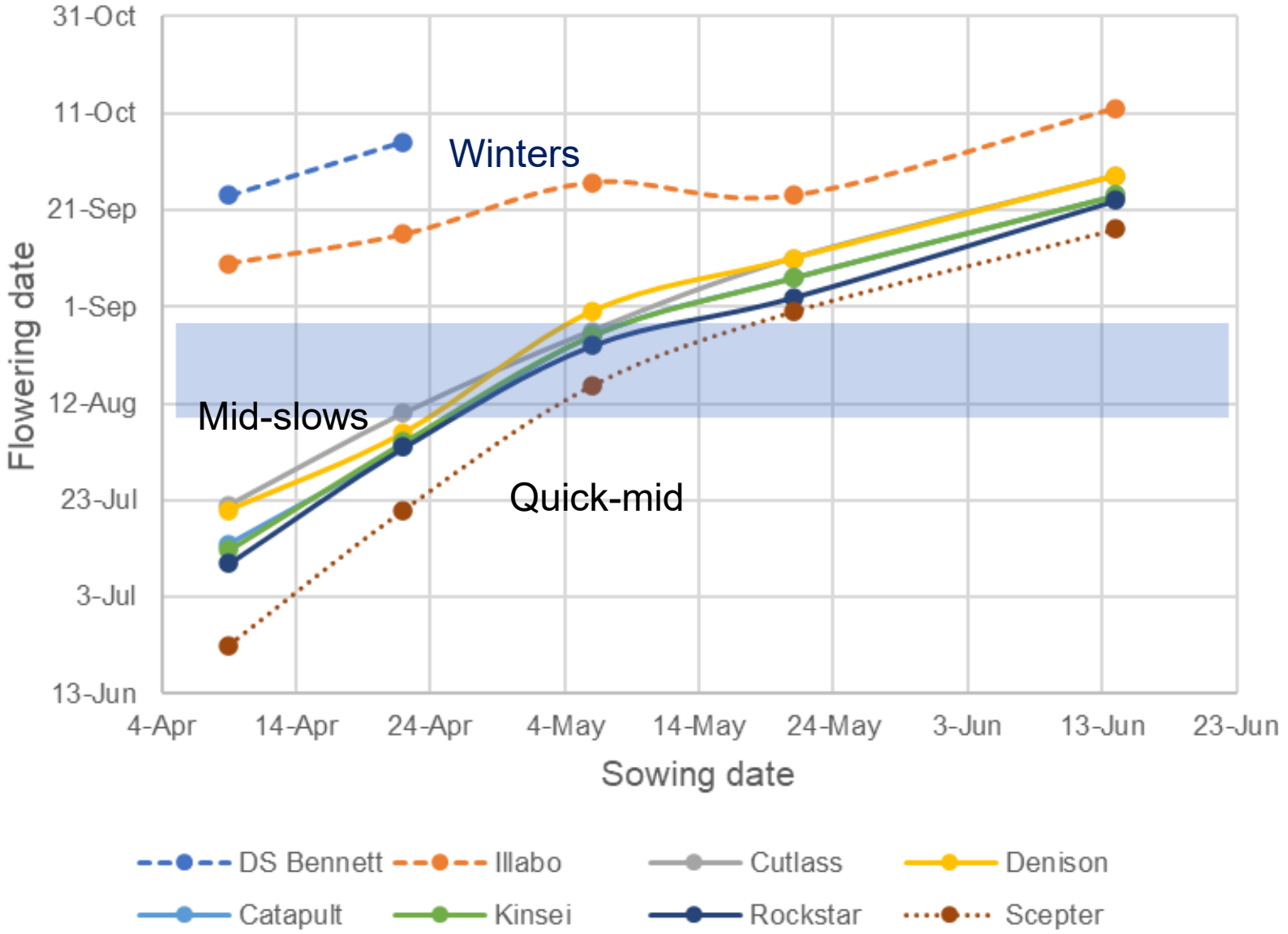
Quick

Quick-mid

Mid

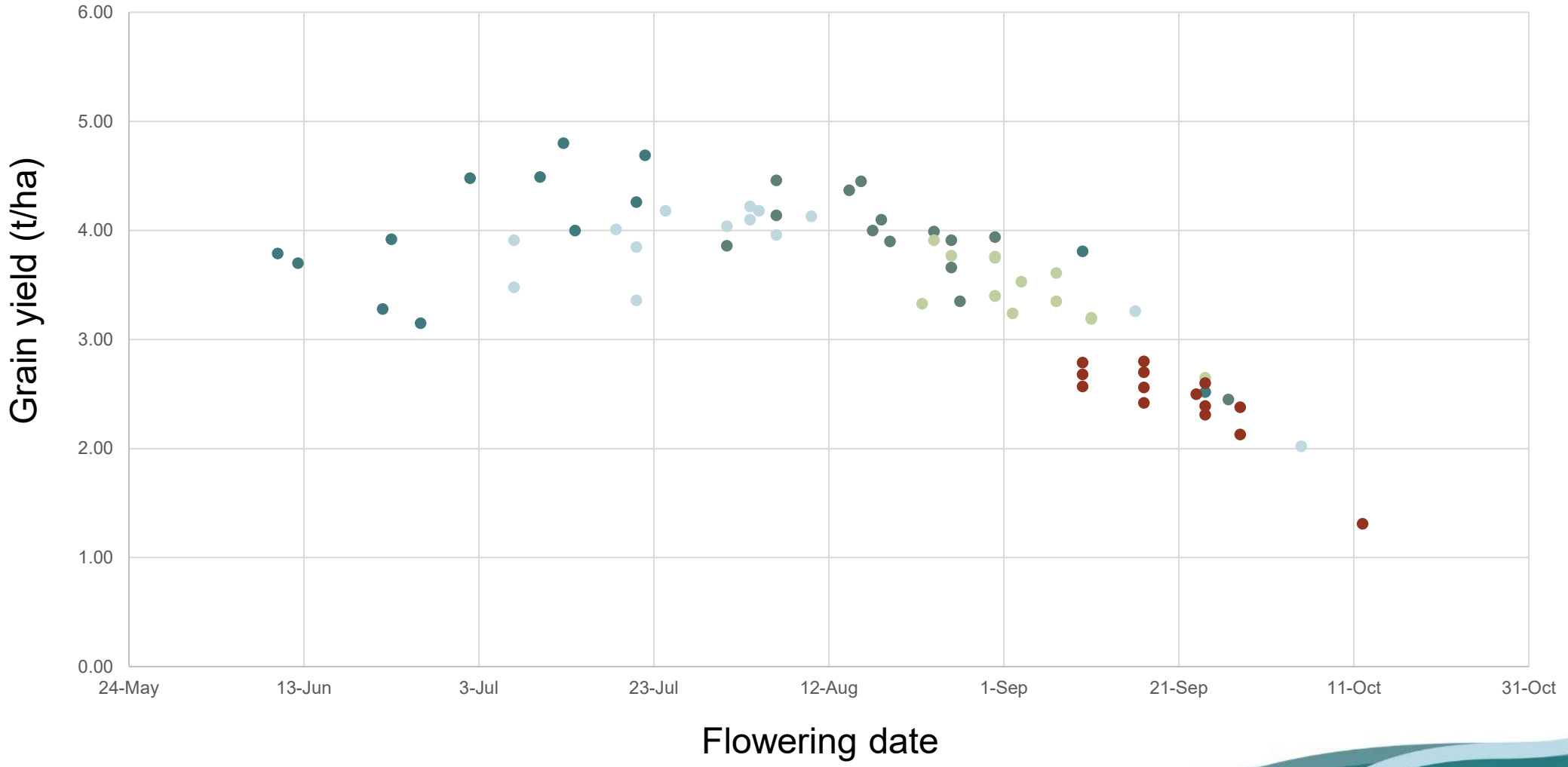
Mid-slow

*NVT sites include Northern: Eradu, Nabawa, Mullewa, Oglivie and Yuna; Southern: Gnowangerup, Kojonup and Narrogin



Mullewa 2021 sowing date vs. flowering date

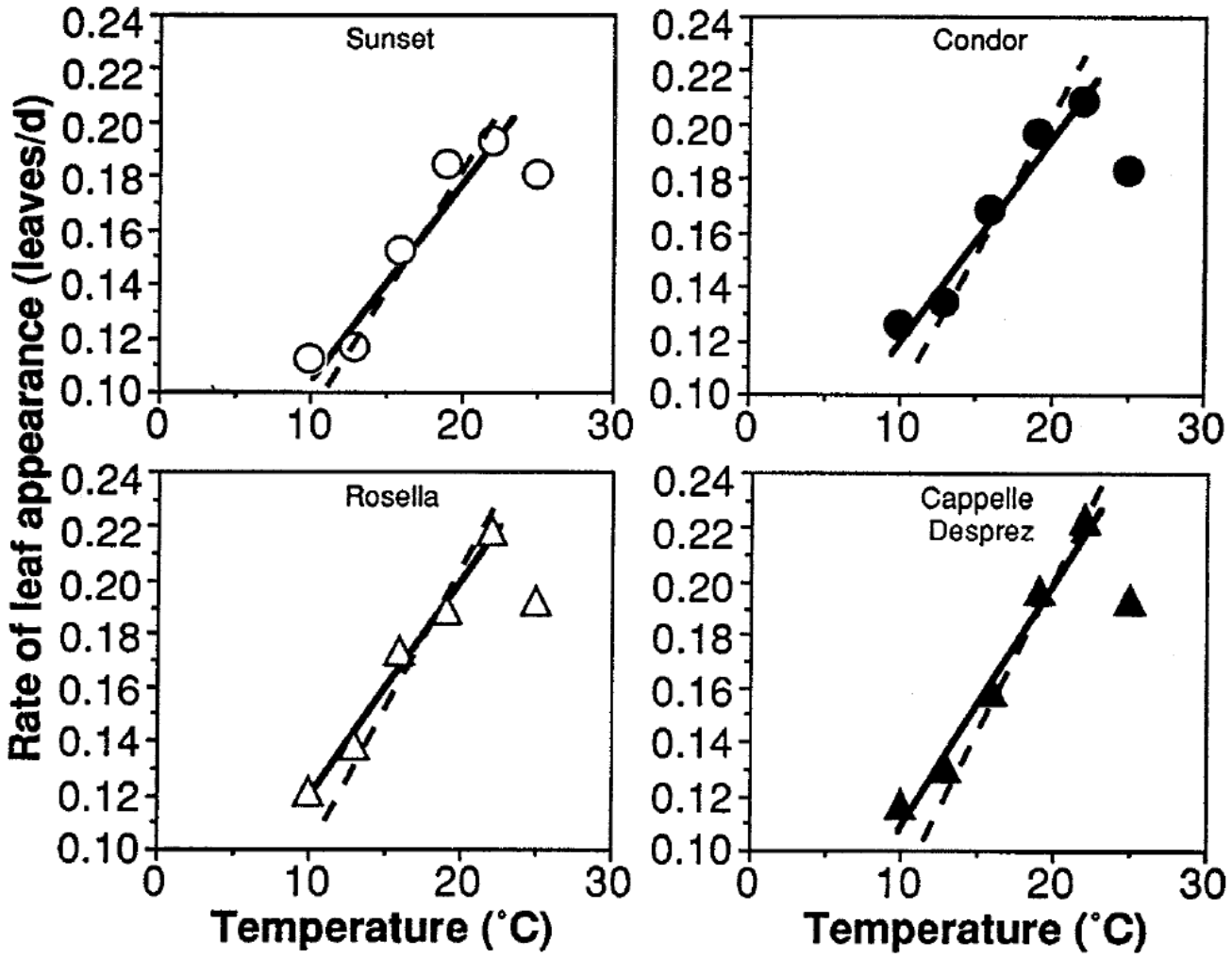
Yield by flowering date – Mullewa 2021



Drivers of wheat phenology

- Temperature (heat sums)
- Vernalisation (cold accumulation)
- Photoperiod (day length)

Temperature response in wheat



Slafer & Rawson, 1995. Aust. J. Plant Physiol. 22, 913-926

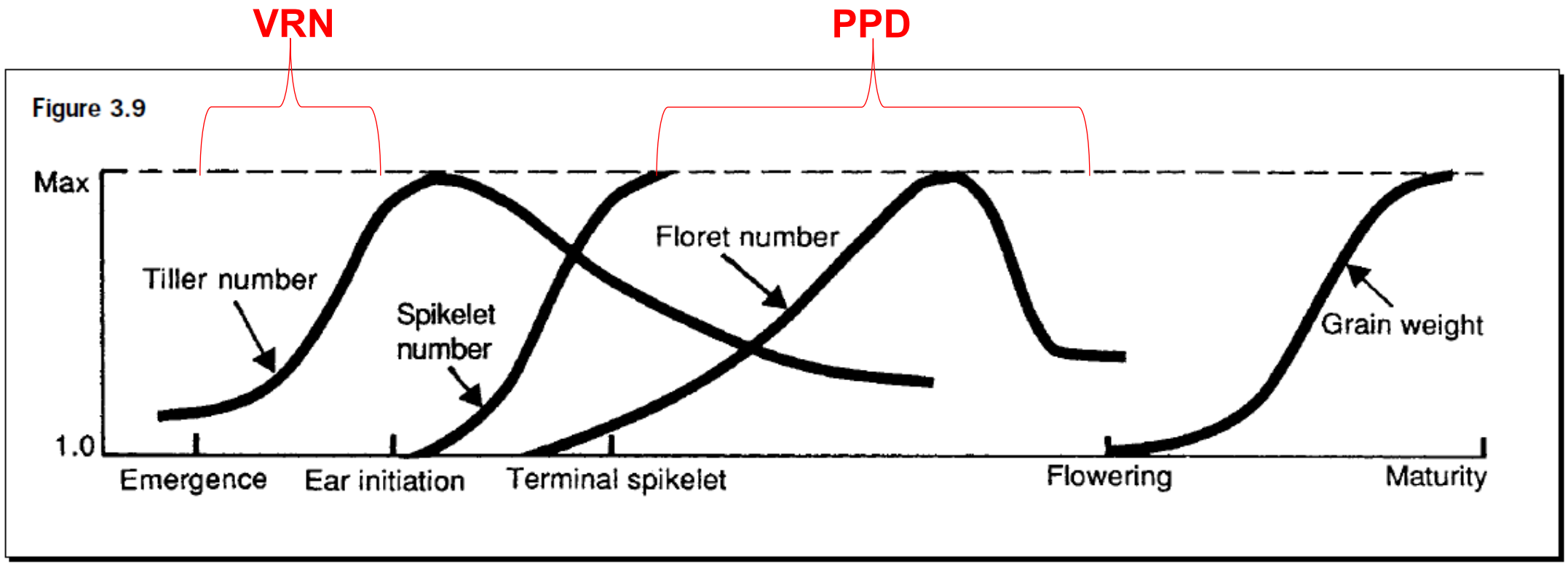
- Response is not linear beyond certain temperatures
- High temperature responses can change with acclimation
- Contradictions in base and optimum temps. in studies
- Thermal time as mean of min-max used in most models

Vernalisation:

- Delays by extending vegetative phase
- Negates most of the early heat and therefore generally most stable

Photoperiod:

- Delays flowering by extending stem elongation phase
- Generally less stable with heat/early drought in very early sowing



Representation of the development of the yield components through the life cycle of the crop.

Setter et al. 2000, in The Wheat Book, p. 48

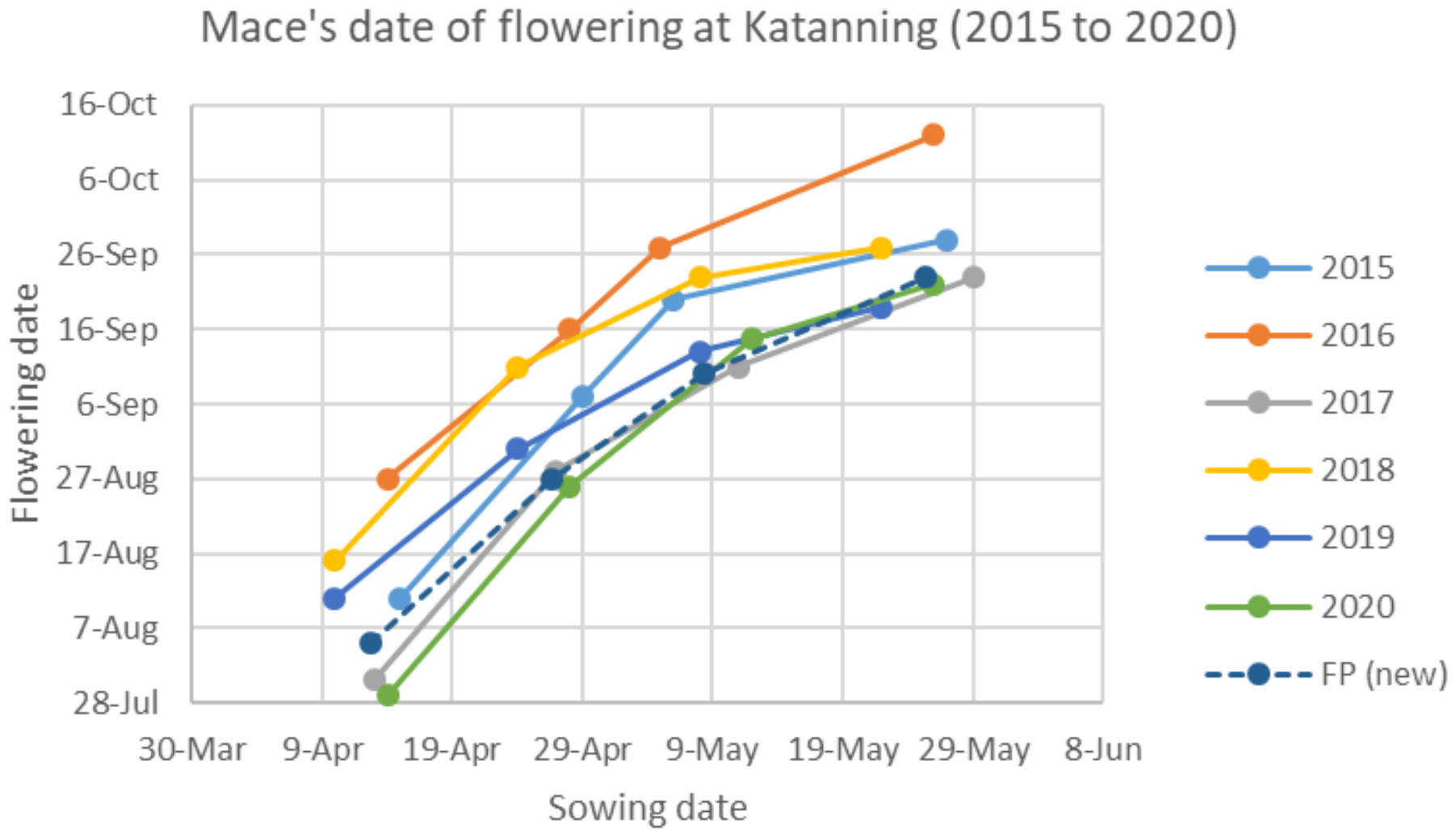
Major phenology alleles

	Cultivar	Ppd-A1	Ppd-B1	Ppd-D1	Vrn-A1	Vrn-B1	Vrn-D1
Quick	AXE	b	a	a	a	a	v
Quick	CORACK	b	b	a	v	a	a
Quick	EMU_ROCK	b	b	a	a	a	v
Quick	WESTONIA	b	a	a	a	a	v
Quick-mid	MACE	b	a	a	v	a	v
Quick-mid	SCEPTER	b	b	a	v	a	v
Quick-mid	WYALKATCHEM	b	b	a	v	a	v
Mid-slow	CALINGIRI	b	d	a	v	a	v
Mid-slow	CAMM	b	b	d	a	a	v
Mid-slow	DENISON	b	b	a	v	a	v
Mid-slow	ENDURE	b	b	d	a	a	v
Mid-slow	MAGENTA	d	b	a	v	a	v
Mid-slow	SPEAR	b	b	d	a	a	v
Mid-slow	STILETTO	b	b	d	a	a	v
Mid-slow	TROJAN	b	a	c	v	a	a
Mid-slow	YITPI	b	b	d	a	a	v
Winter	LONGSWORD	b	b	a	v	v	v
Winter	ROSELLA	b	a	d	v	v	v
Winter	WHISTLER	b	d	a	v	v	v
Winter	OSPREY	b	a	a	v	v	v
Winter	EGA_WEDGETAIL	b	b	a	v	v	v

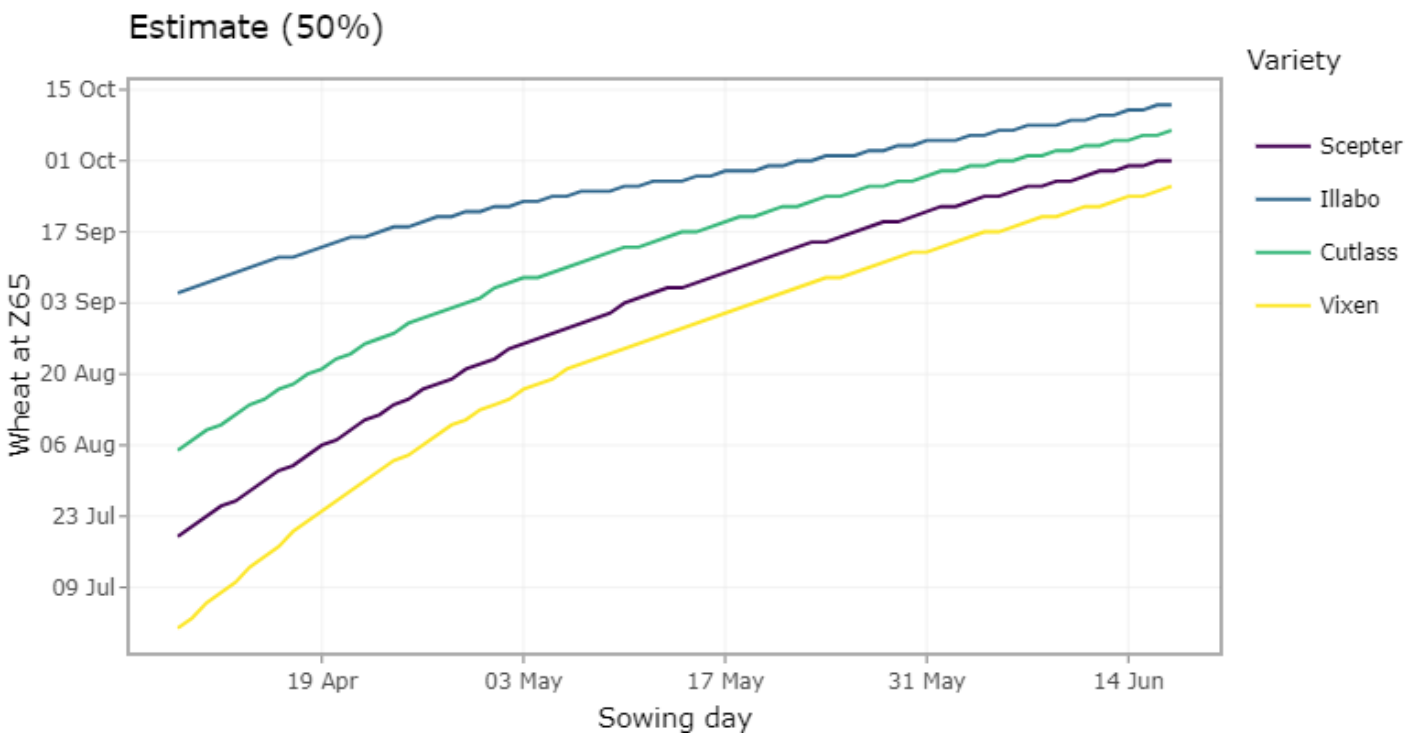
Major phenology alleles/genes do not adequately distinguish the maturity of commercial varieties

	Cultivar	Ppd-A1	Ppd-B1	Ppd-D1	Vrn-A1	Vrn-B1	Vrn-D1
Quick-mid	SCEPTER	b	b	a	v	a	v
Mid-slow	DENISON	b	b	a	v	a	v

Flowering times can change more each season than the target flowering window duration



FlowerPower phenology model



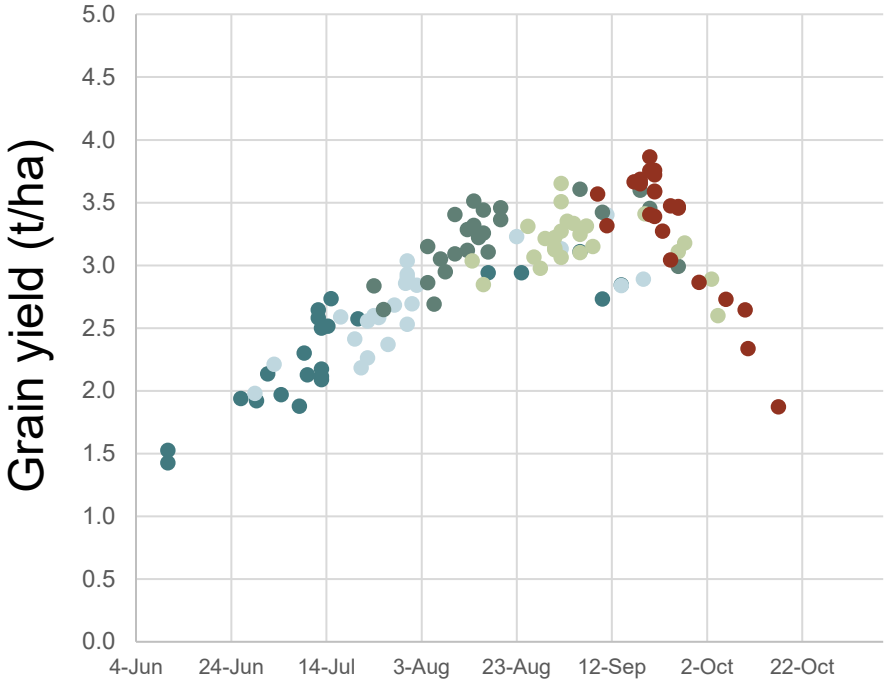
- Wheat (Z65), barley (Z49) and oats (Z71)
- Important in showing relative differences across germination dates (not predictions)

fp.dpird.app

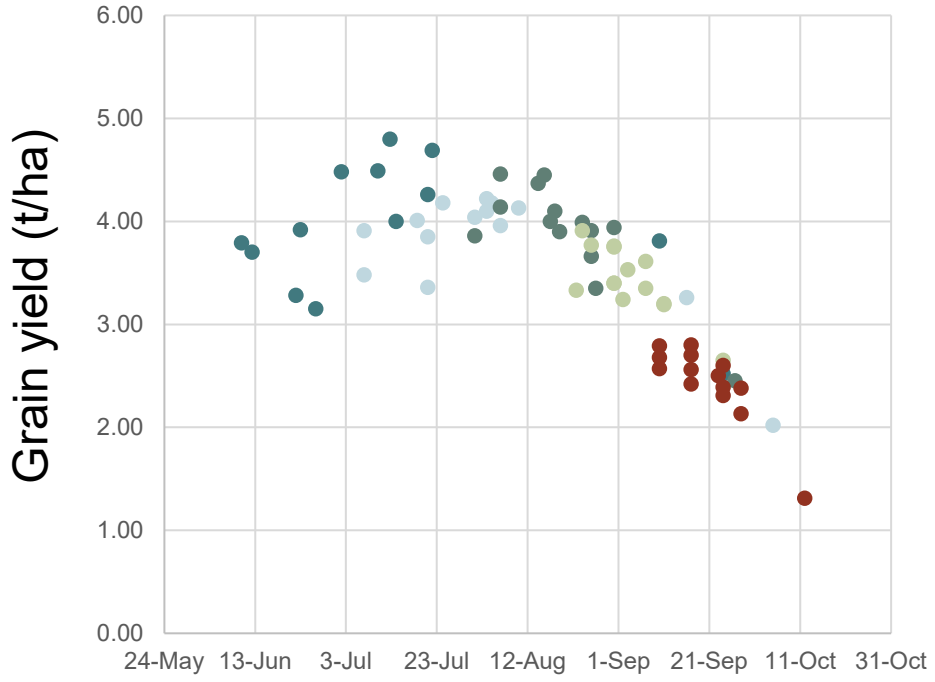
Mullewa TOS data

- Rainfall timing as an example can dramatically shift the ‘optimum’

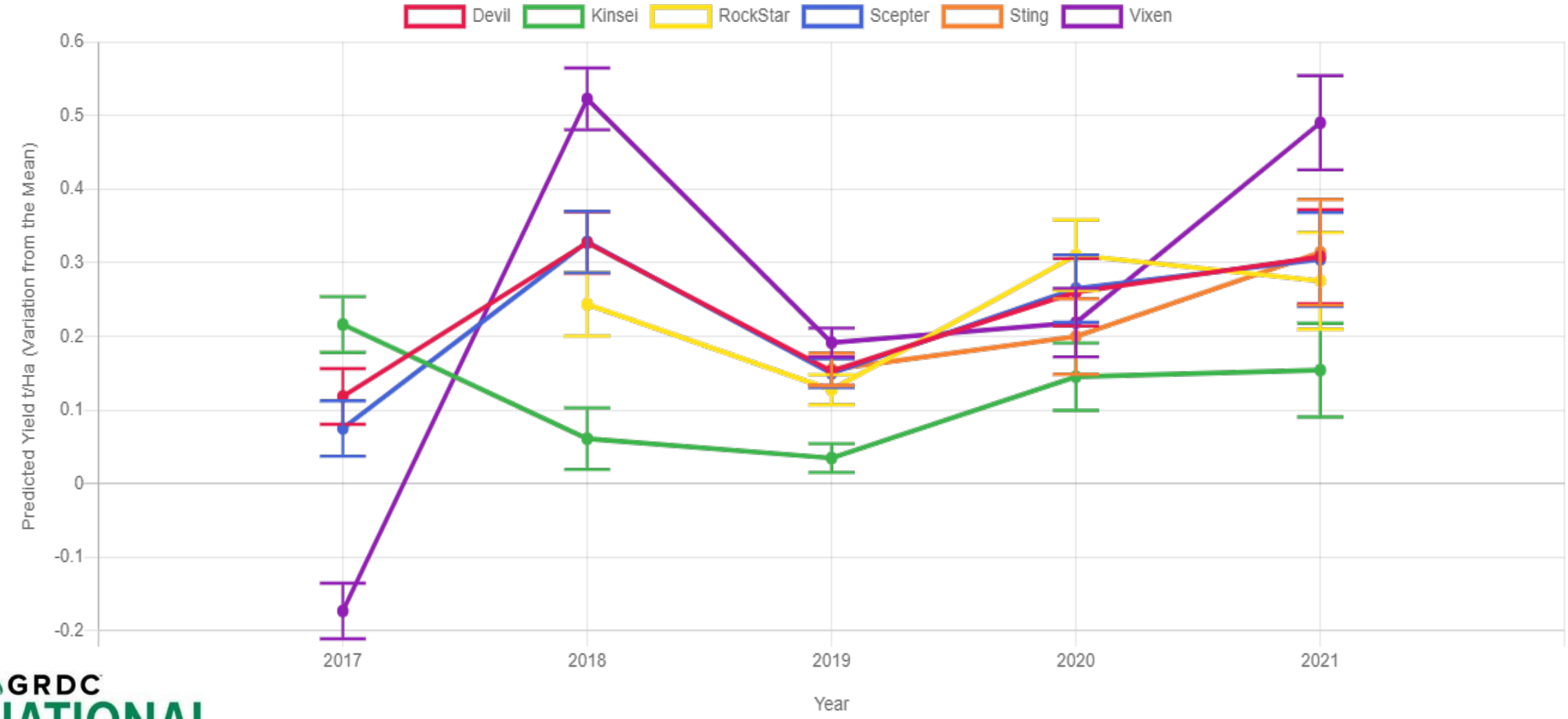
Mullewa 2017



Mullewa 2021



5 yr NVT data Agzone 1 - MET



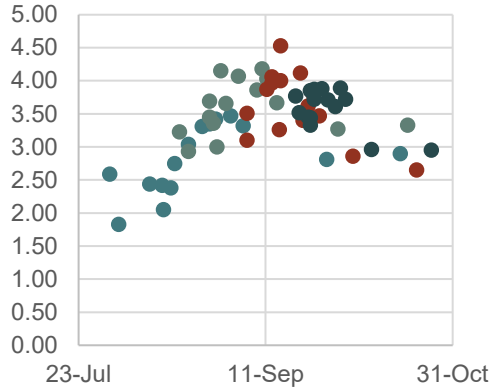
GRDC NATIONAL VARIETY TRIALS™

https://www.nvtonline.com.au

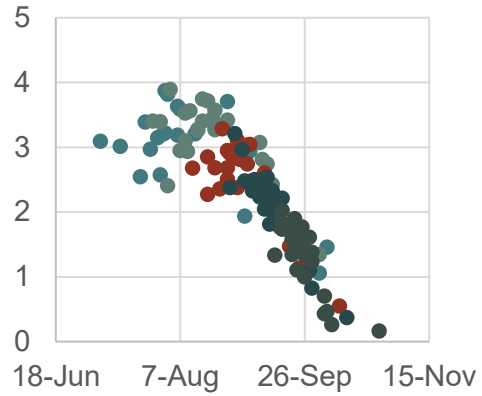
Multiple sites – grain yield × flowering date

Grain yield (t/ha)

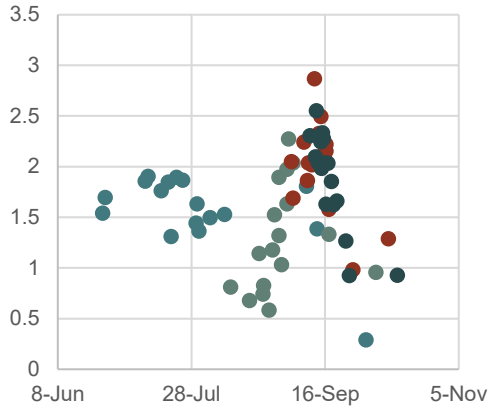
Katanning 2021



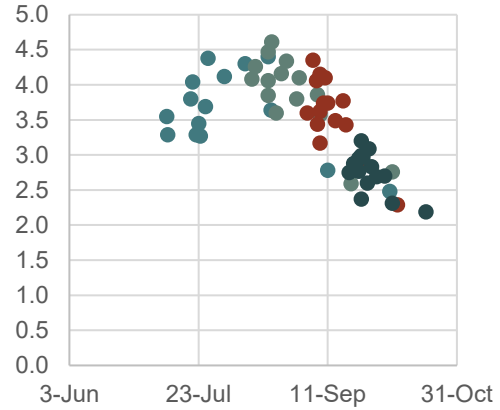
Merredin 2020



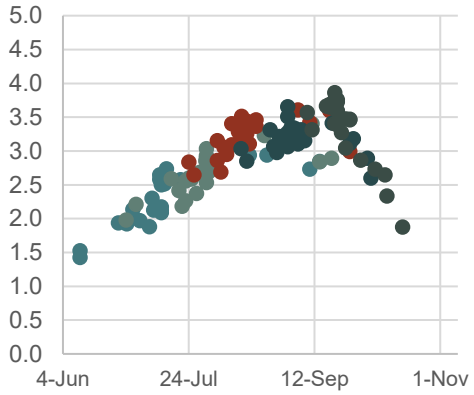
Merredin 2021



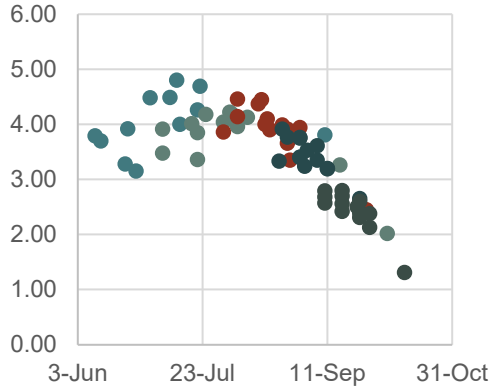
Grass Patch 2021



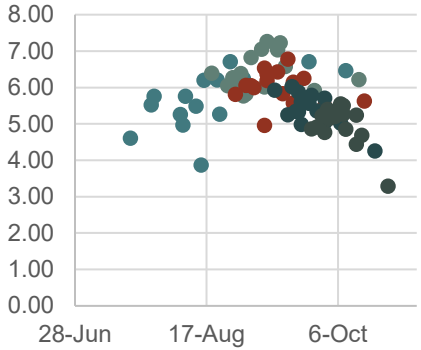
Mullewa 2017



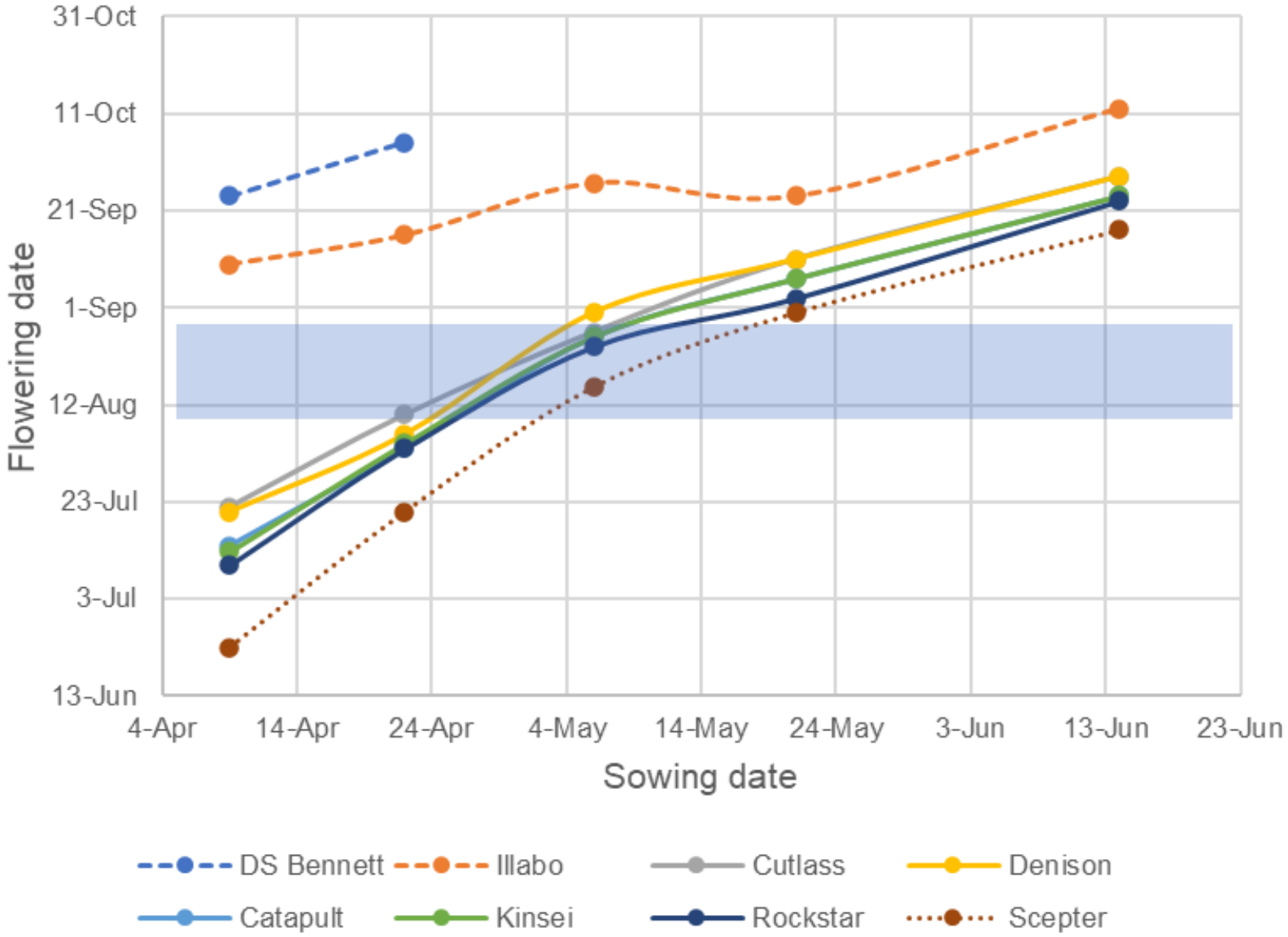
Mullewa 2021



Dale 2021



Flowering date


31-Oct
11-Oct
21-Sep
1-Sep
12-Aug
23-Jul
3-Jul
13-Jun
Flowering date
4-Apr
14-Apr
24-Apr
4-May
14-May
24-May
3-Jun
13-Jun
23-Jun
Sowing date
DS Bennett
Illabo
Cutlass
Denison
Catapult
Kinsei
Rockstar
Scepter

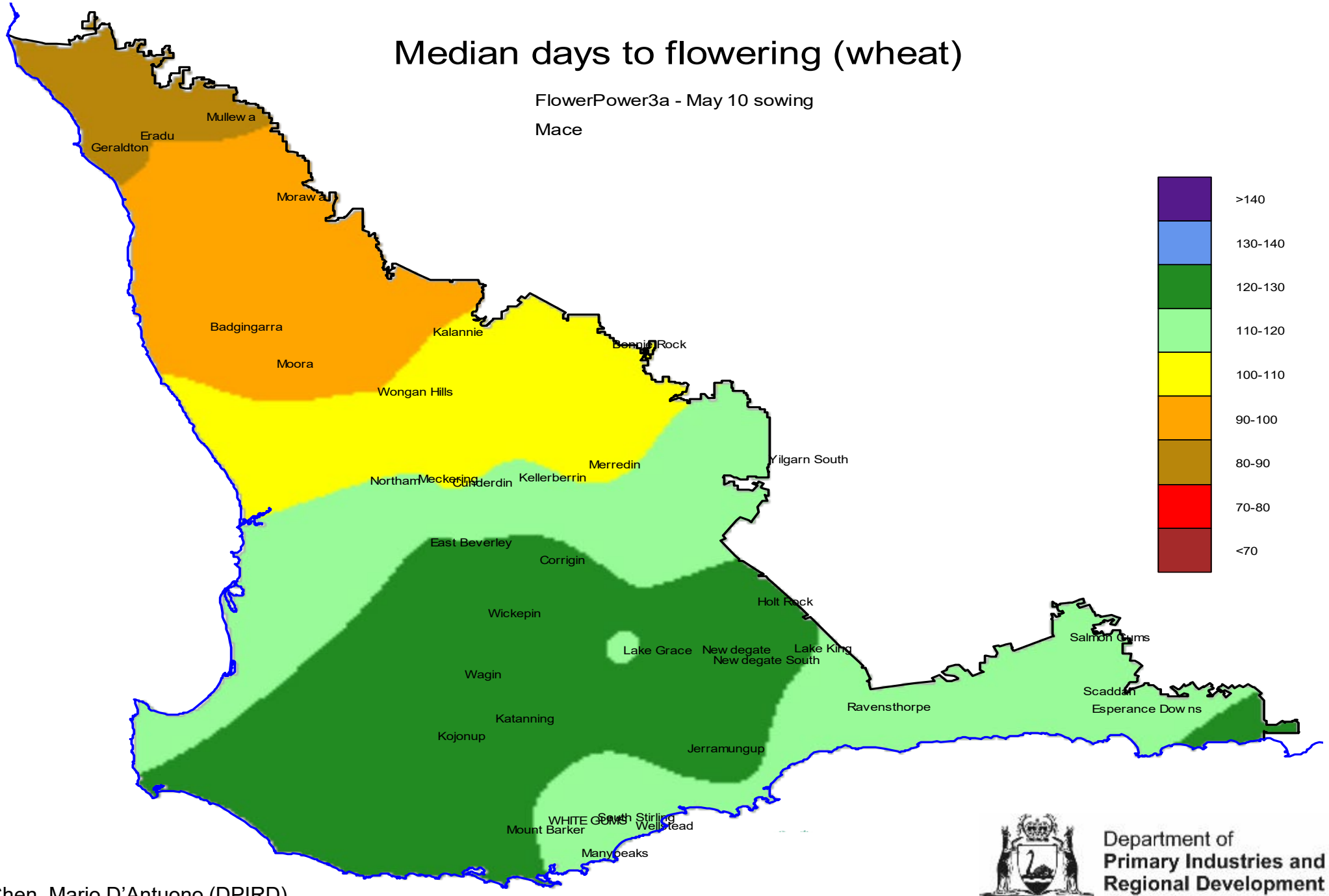
‘Optimal flowering period’

- Definitions tended to have been about frost and heat/terminal drought
- Dry matter shows that determinate crop benefits from extended growth for optimum biomass prior to stress
- Seasonality…
  - Growth patterns and limitations
  - Rainfall timing…
- Optimum time for flowering can shift season to season (as can flowering time)
- Re-tillering may likely cover some of the poor performance… but with big risk in quality etc.

Median days to flowering (wheat)

FlowerPower3a - May 10 sowing

Mace



Source: Kefei Chen, Mario D'Antuono (DPIRD)

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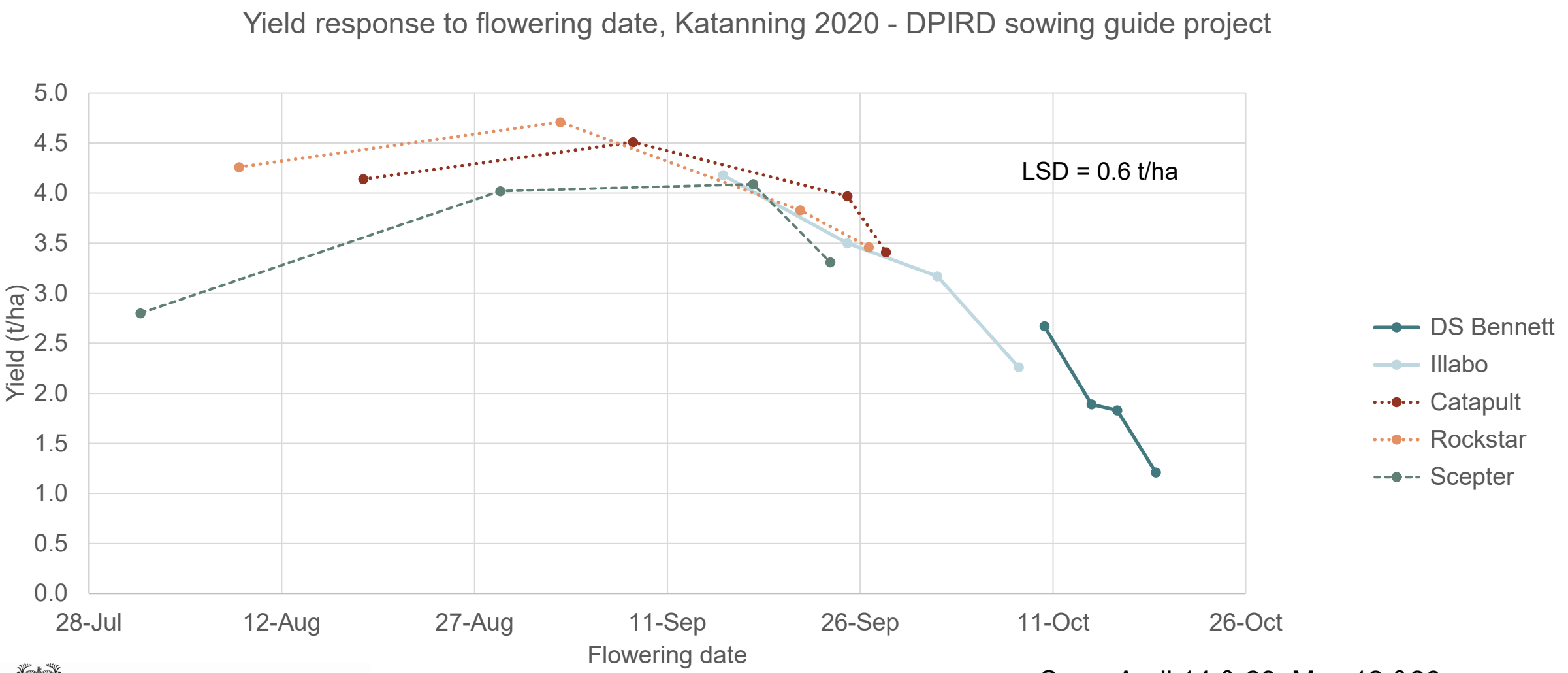
Suggested sowing (germination) dates

TABLE 12. Suggested sowing times of wheat varieties in WA (assumes low frost risk)

AGZONES 1-6	April				May				June			
	wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4	wk 1	wk 2	wk 3	wk 4
Mid–slow and slow: Brumby, Catapult, Cutlass, Denison, Kinsei, Magenta, RockStar, Yitpi, Valiant CL Plus, Zen												
Quick–mid to mid: Calibre, Chief CL Plus, Devil, Hammer CL Plus, LRPB Havoc, Mace, Ninja, Scepter												
Quick: Emu Rock, LRPB Anvil CL Plus, LRPB Avenger, Sting, Vixen												

= earlier than ideal = optimum sowing time = later than ideal but acceptable



Sown April 14 & 28, May 12 &26

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Risks across flowering window

- Early
  - Reduced biomass (Yield potential)
    - Slower maturing still advantage
  - Frost (+ frosted grains)
    - Frost= Oats > barley > wheat
  - Sprouting/low falling number
    - Increase scrutiny in early flowering
  - Blackpoint
    - Increase scrutiny in early flowering
- Late
  - Reduced biomass (yield potential)
  - Terminal drought (particularly with high biomass)
  - Crown rot (expression)

Early sowing – New?

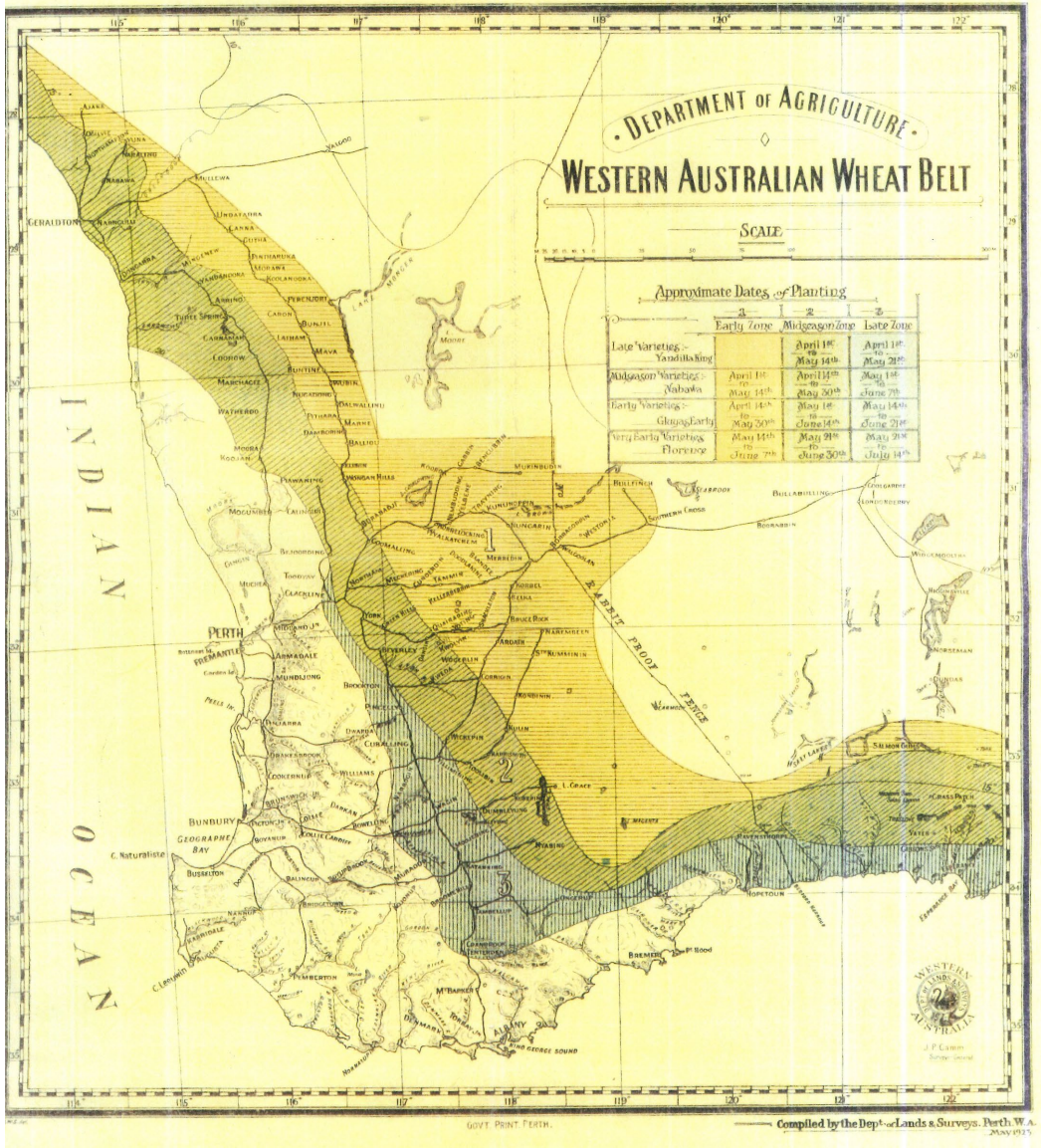
- Zone based variety recommendations from the 1st April

Approximate Dates of Planting

	1 Early Zone	2 Midseason Zone	3 Late Zone
Late Varieties :- Yandilla King		April 1st to May 14th	April 1st to May 21st
Midseason Varieties :- Nabawa	April 1st to May 14th	April 14th to May 30th	May 1st to June 7th
Early Varieties :- Gluyas Early	April 14th to May 30th	May 1st to June 14th	May 14th to June 21st
Very Early Varieties Florence	May 14th to June 7th	May 21st to June 30th	May 21st to July 14th

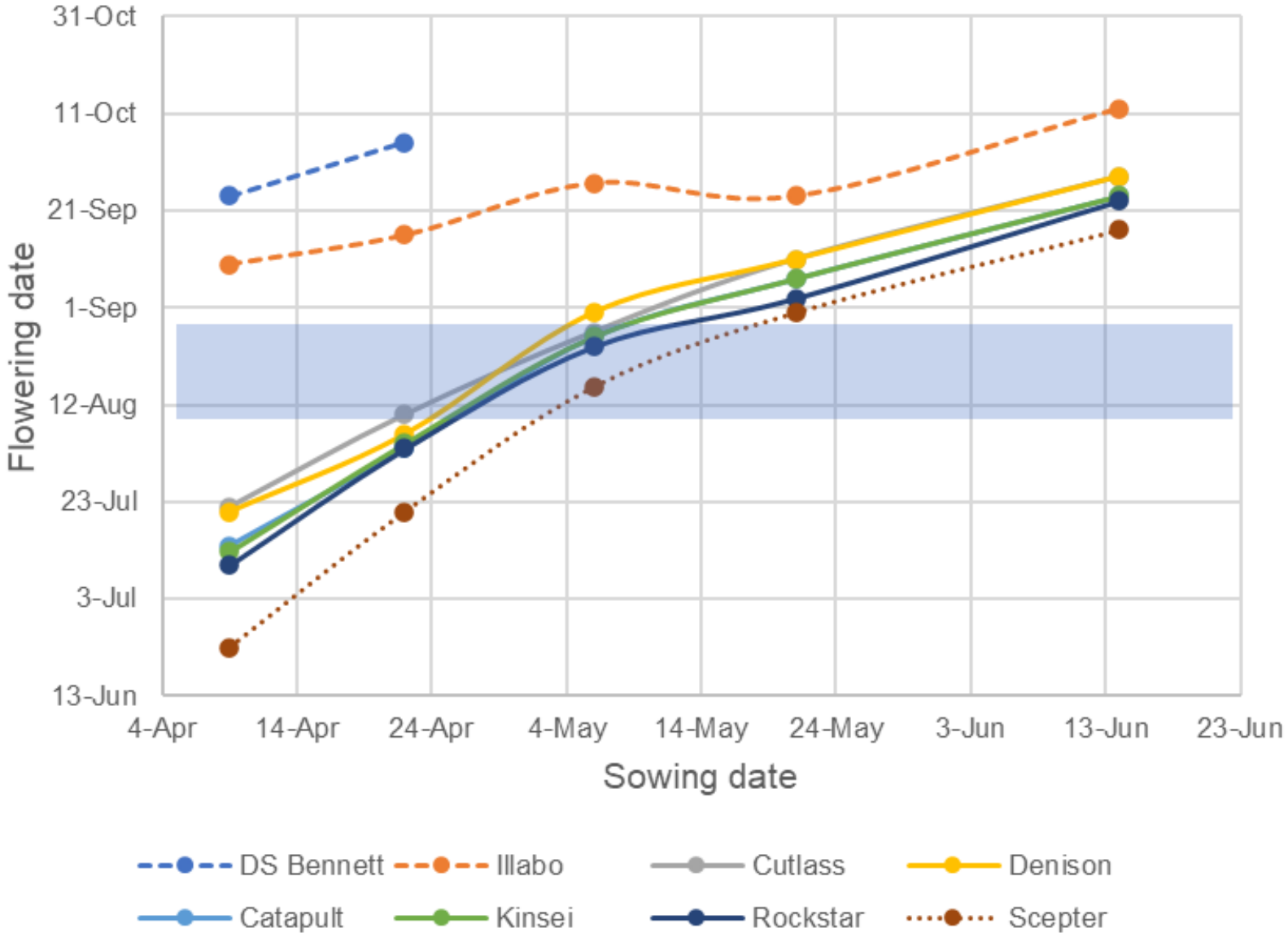
THE DESIRABLE CHARACTERISTICS OF A VARIETY ARE:

1. Suitability for the District in which it is grown.
2. Ability to yield well.
3. Strength of Straw.
4. Absence of Shedding.
5. Ability to resist diseases (Smut, Rust, Septoria).



Using winter wheats in WA

- In DPIRD TOS data, mid-slows have typically out-yielded winters in mid-April
- Winter growth habit can miss the season
- Where terminal drought risk is low-moderate
- When germination is possible early enough
- Where system risks make good sense (e.g. following wet summer and targeting paddocks which may become untrafficable)
- Where mid-slows maybe too risky (e.g. frost risk area - other crops?)


31-Oct
11-Oct
21-Sep
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4-Apr
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3-Jun
13-Jun
23-Jun
Sowing date
DS Bennett
Illabo
Cutlass
Denison
Catapult
Kinsei
Rockstar
Scepter

Do we manage the agronomy of the maturity classes differently?

- Sowing depth and plant density – earlier sowing to compensate with more stems/larger plants
- Nitrogen timing
  - Environment drives majority of the result
  - Grazing winters better with early N
- Herbicides – Extended vegetative phase of winters remains an opportunity, further work needed.
- Disease? More work needed. Refer to some of Jeremy's with take-all and poor yields in the very early sowing

Key messages

- Phenology imperfect but important
- Targeting germination times with maturity types will improve yield and reduce risk in most seasons
  - Crop diversity
- Adjusting these ‘rules’ by risks and opportunities of site and season

Thank you

dpird.wa.gov.au

Acknowledgements:

DPIRD Wheat Agronomy
DPIRD Field research support
FlowerPower 7 – Kenyon Ng, Brenda Shackley, Dean Diepeveen

GRDC NVT Online

Relative yield gains in mid-slow maturity

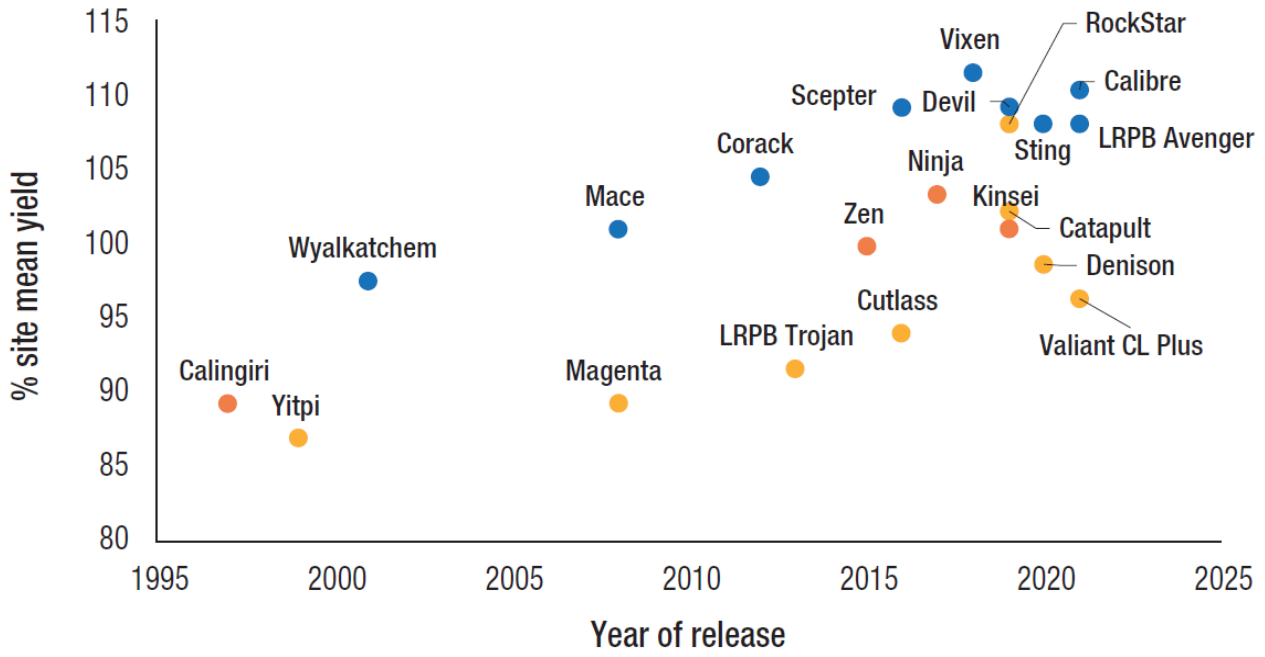


FIGURE 1. Wheat yield improvement in WA (based on NVT MET analysis 2017–2021, all Agzones, 192 NVT sites). Blue dots are top performers, orange dots are ANW varieties and yellow dots are mid–slow maturing varieties. Average yield is 3.12t/ha.

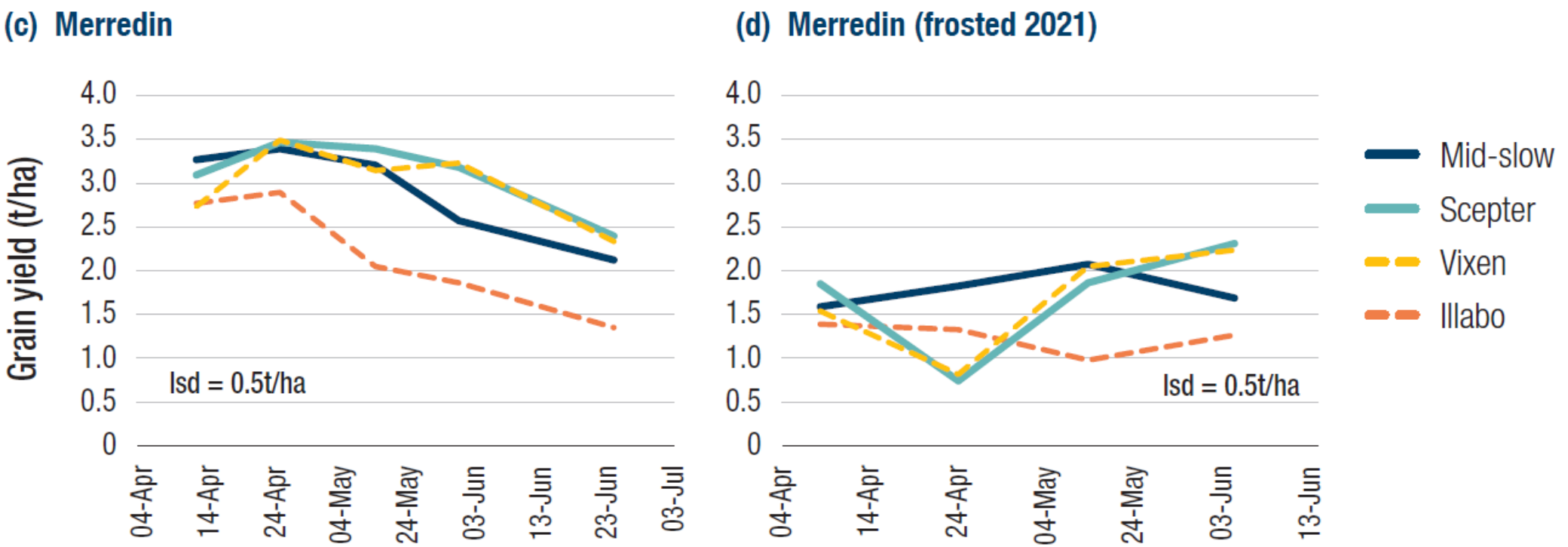
Source: NVT Online, nvtonline.com.au

Overview

- List of wheat maturity types and their behaviour
  - Functions affecting wheat phenology (cardinal temps, thermal time, VRN and PPD)
- Genetics/traits determining these types
  - How determinate/clear-cut is this?
- Predictability and changing responses across seasons
  - Variability of flowering dates between seasons
  - Show thermal profiles of compared seasons – when does most variation occur? – early
- What does it mean for planning? How does this vary across the state?
- How perfect does it need to be? Uncertainty of season etc.
- What other factors affect phenology? – density, sowing depth, nutrition?
- What factors need additional consideration across types?
  - Quality risk profiles, diseases? Etc.
- What should change? Less arguing about 3 d differences etc. Challenge concepts of efficiency in less varieties – how much time does it take to swap out – harvest? Seeding? If changing a variety gave extra 300 kg/ha over 1 week sowing (say 1000 ha = 300 t = $90 k)
- Other crops are diversification – just depends on the strengths/weaknesses… what are their sowing time responses…
  - Canola, pulses, lupins, oats, barley
- Take home messages
  - early sowing/germination has greatest upside of variety/phenology diversification
  - Variety specific agronomy is clearest when managing a varieties weakness/fault
  - Season drives potential, phenology choices are for managing trade-offs across scenarios
- Screw optimizing, just make better decisions

Wheat maturity types

- Quick, mid-quick, mid, mid-slow, slow and winter (insert table)
- Phenology genes/alleles not clear cut (table of genes and explanation of what they do)
- Sowing window recommendations – across the state, quite similar
  - Flowering time windows change, but so does the phenology.
- How does the phenology change through the germination dates?
  - Show temp profile through season and thermal time.
  - Plant perspective – stresses can negate


(c) Merredin
(d) Merredin (frosted 2021)
Grain yield (t/ha)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
lsd = 0.5t/ha
lsd = 0.5t/ha
04-Apr
14-Apr
24-Apr
04-May
24-May
03-Jun
13-Jun
23-Jun
03-Jul
Mid-slow
Scepter
Vixen
Illabo