

Examining the **seeding date and yield relationship** for various crops using producer-reported data

CHRISTIANE CATELLIER – IHARF

IHARF SOIL & CROP MANAGEMENT SEMINAR

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Seeding date effect

- Previous research has shown:
 - Delayed seeding dates are often detrimental to yield of various crops;
 - Some crops have later optimal seeding dates.
- The effect of seeding date is tied to environmental conditions experienced at important crop development stages.
 - Environmental conditions vary by year and location... but “site-year” effects often averaged out.
- Does the seeding date effect vary between locations? How and why?

Producer-reported data

- SCIC – Saskatchewan Management Plus Program

Average Yield by Variety for Risk Zone 1
 (Average of 100 acres and 3 producers reported)

Crop	Variety	2017		2018		2019		2020	
		Yield	Area	Yield	Area	Yield	Area	Yield	Area
Soybean	AGS 2000	45.2	1,200	48.5	1,100	42.1	1,300	46.8	1,150
	AGS 2001	44.8	1,150	47.9	1,050	41.5	1,250	45.9	1,100
	AGS 2002	45.5	1,250	48.8	1,150	42.5	1,350	47.2	1,200
	AGS 2003	44.9	1,100	47.5	1,000	41.8	1,200	45.5	1,100
	AGS 2004	45.1	1,200	48.2	1,100	42.2	1,300	46.5	1,150
	AGS 2005	44.7	1,150	47.6	1,050	41.6	1,250	45.8	1,100
	AGS 2006	45.3	1,250	48.6	1,150	42.8	1,350	47.5	1,200
	AGS 2007	44.6	1,100	47.3	1,000	41.4	1,200	45.2	1,100
	AGS 2008	45.0	1,200	48.0	1,100	42.4	1,300	46.8	1,150
	AGS 2009	44.8	1,150	47.4	1,050	41.7	1,250	45.6	1,100



Pros	Cons
- Extensive	- Unbalanced, missing values
- Representative of actual management practices	- Large margin of error

Management Data	Geographical Data	Weather Data
Crop and variety	LLD	Daily Temperature (min, max, mean)
Seeding date	Township	
N, P, K, S rates	RM	
Yield	Crop district	Daily rainfall
	Grain Risk Zone	
	Soil zone	

- Weather data: April – October only, for 131 weather stations
- Each LLD assigned to nearest weather station at the township level

Weather data

Daily Temperature

Daily Cumulative GDD
Average Daily Cumulative GDD

Seasonal GDD
Average Seasonal GDD

Last spring frost, Average LSF
First Fall Frost, Average FFF
Frost Free Period, Average FFP

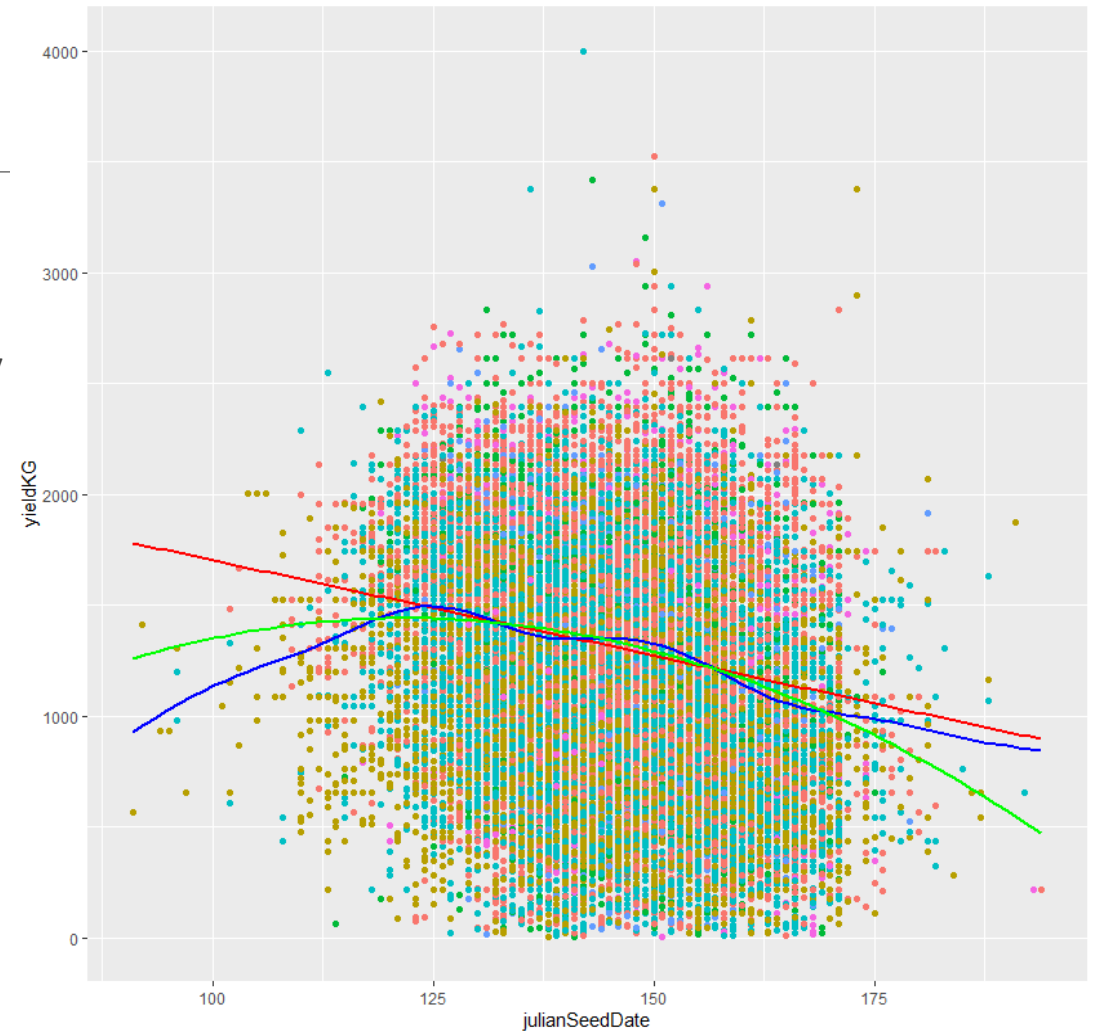
Daily rainfall

Daily Cumulative rainfall
Average Daily Cumulative Rainfall

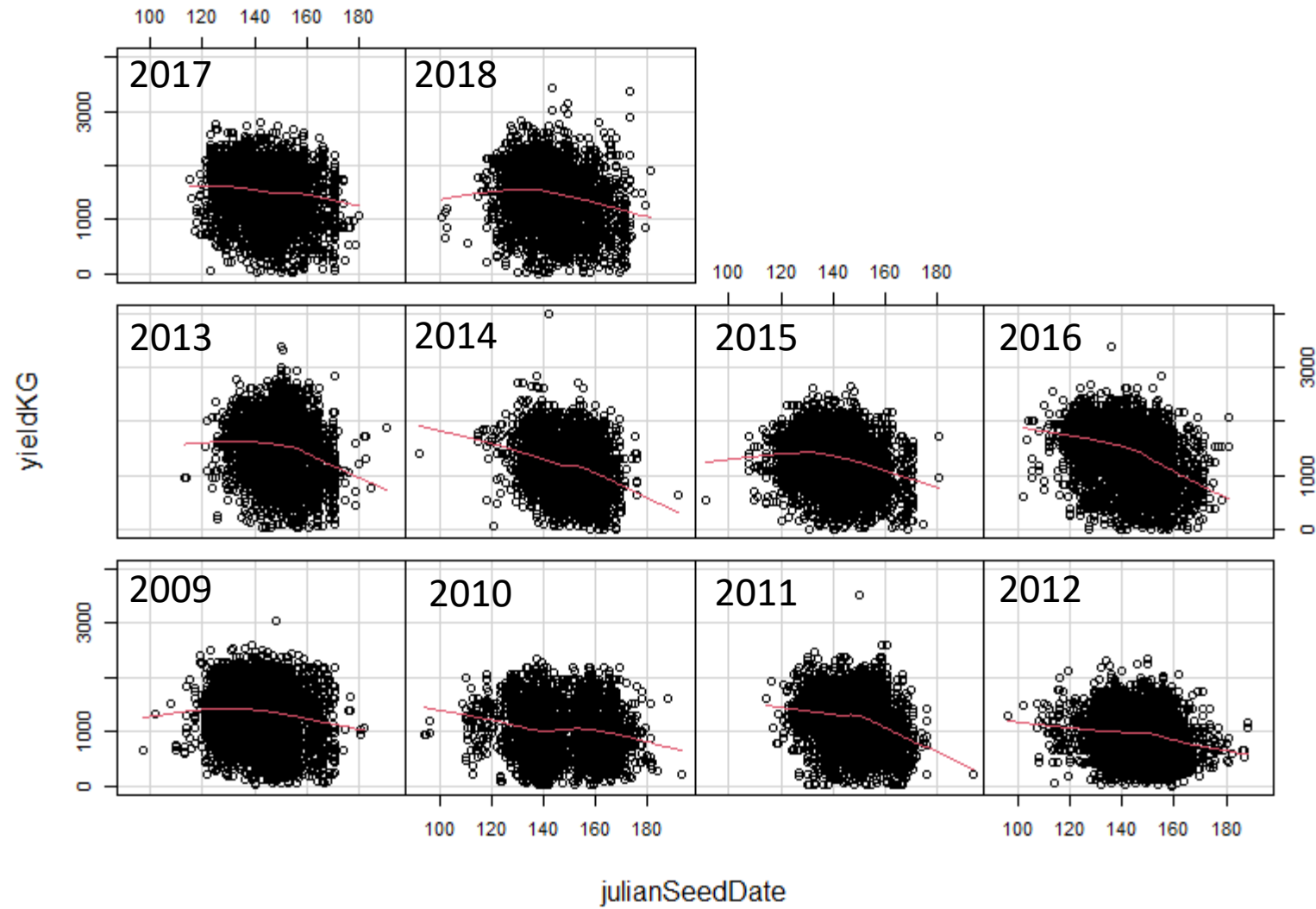
Seasonal rainfall
Average Seasonal rainfall

Statistical modelling

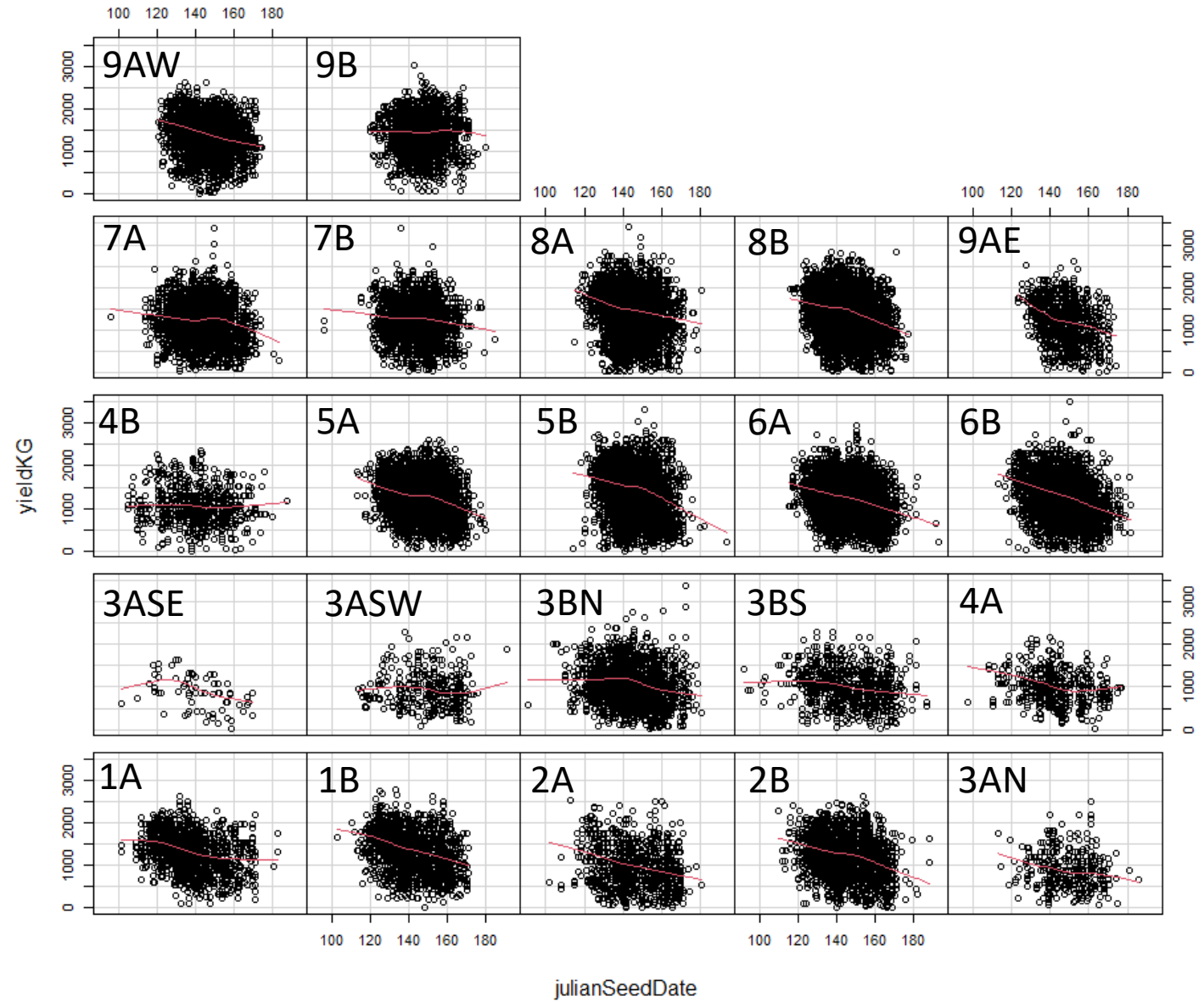
- Mixed Effects Models
 - Linear relationship (red): loss in yield with delay in seeding date
 - Quadratic relationship (green): optimal seeding date, and yield loss with early and later seeding dates
- Generalized Additive Models
 - Smoothed curve relationship (blue): “Natural” response curve



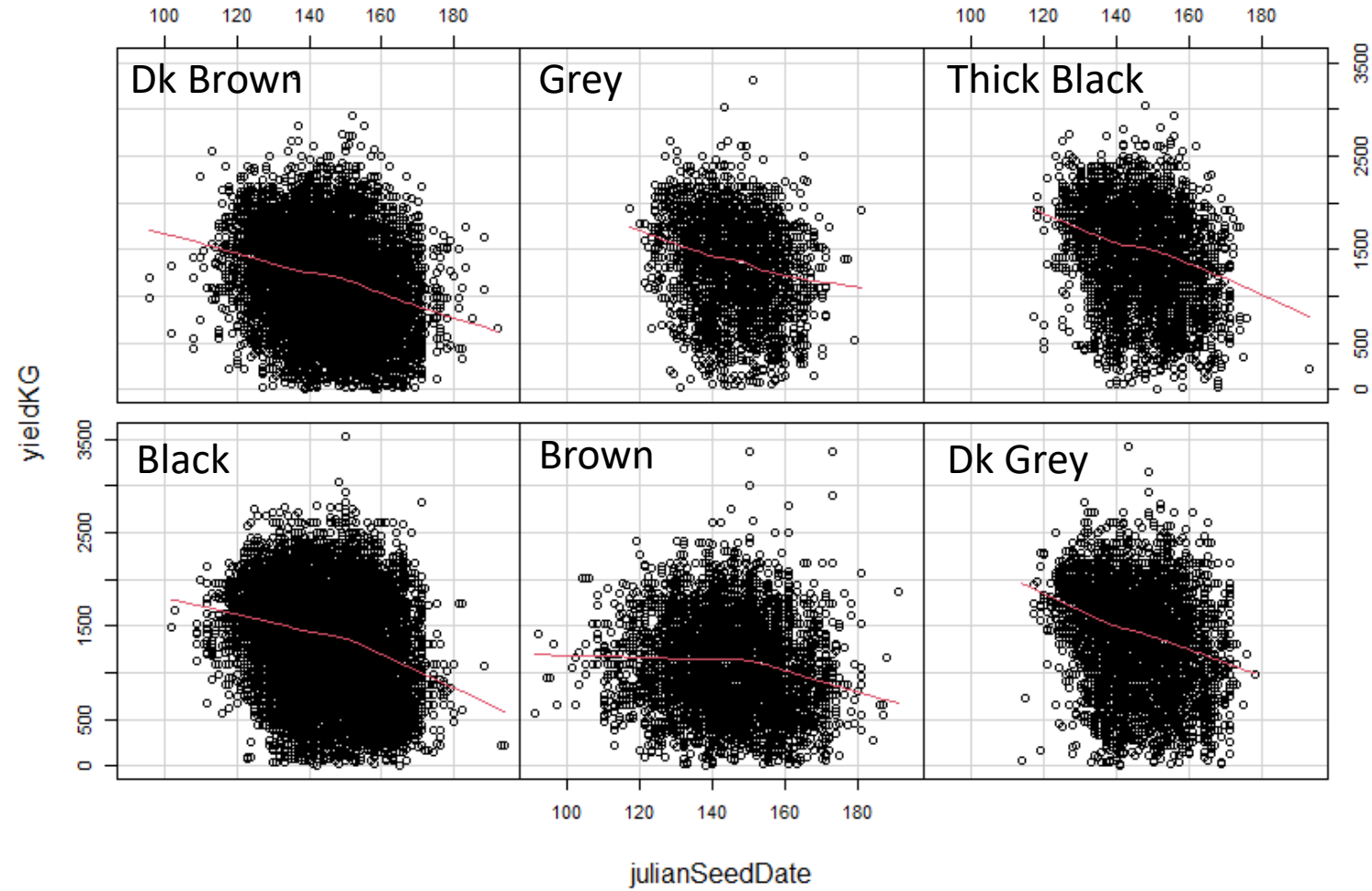
Results: Barley



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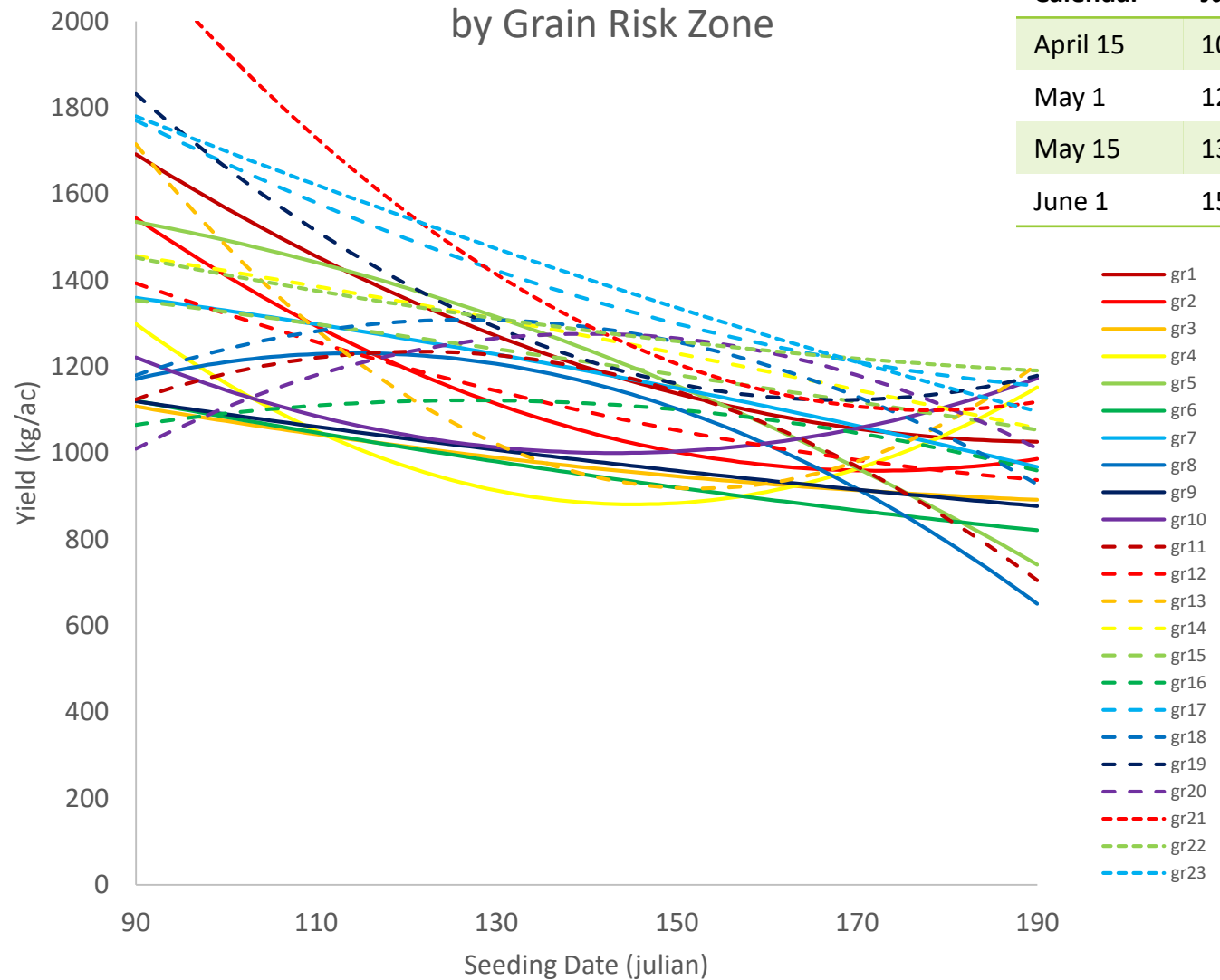
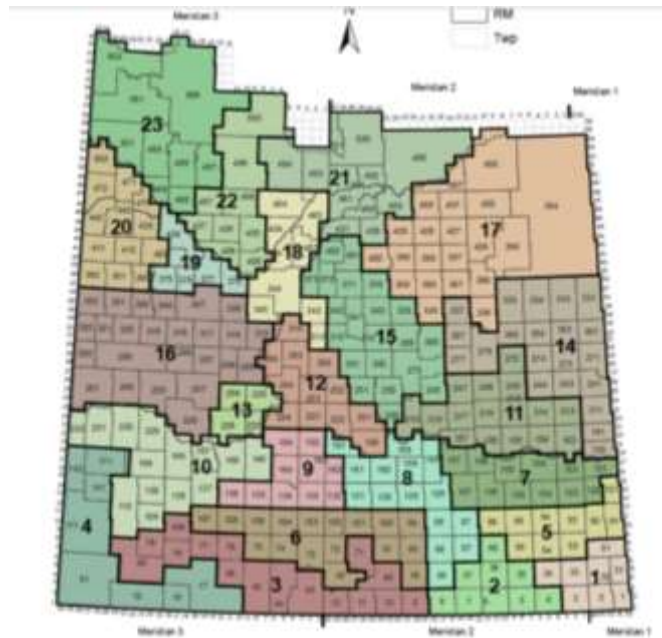


Results: Barley



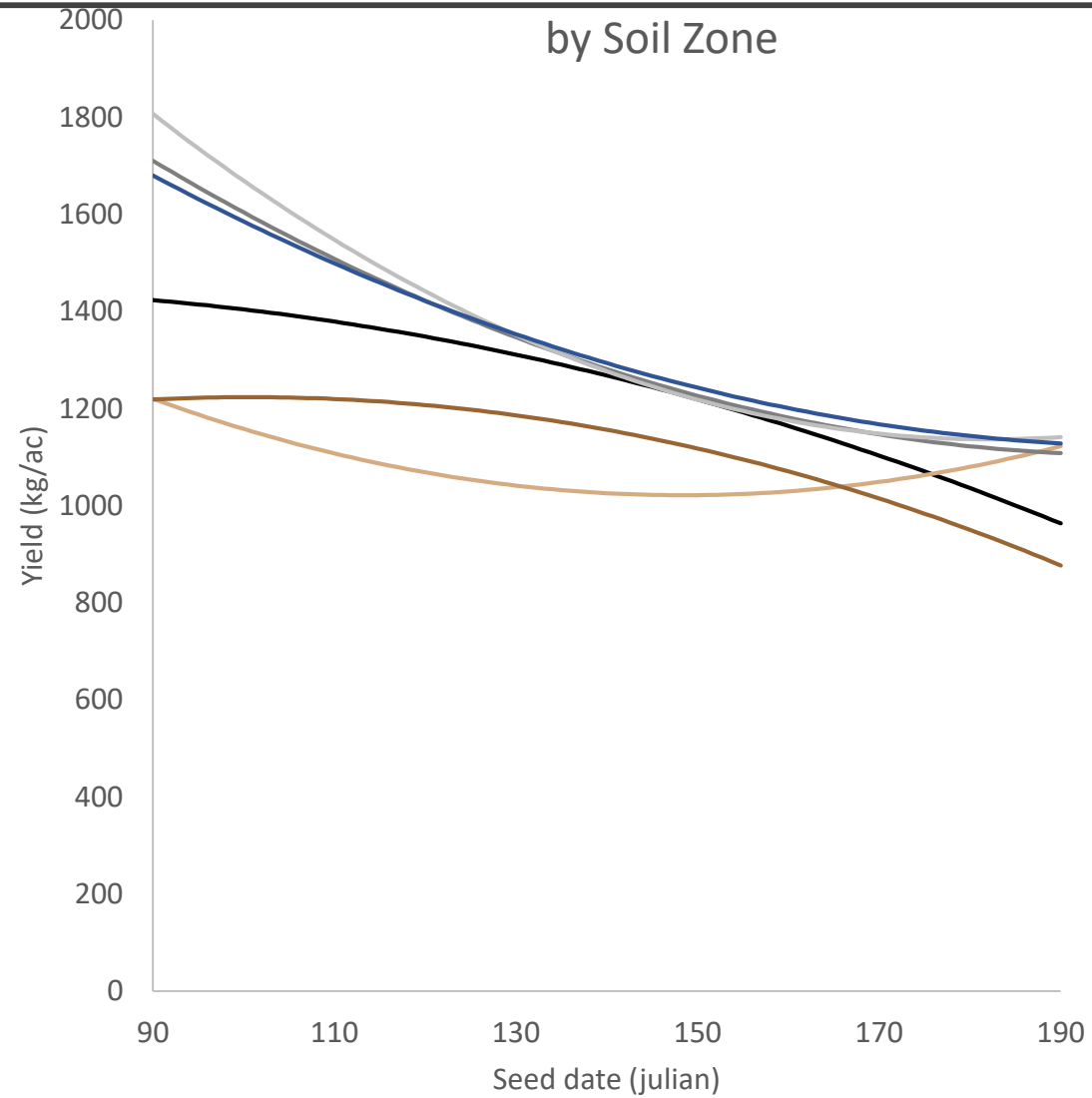
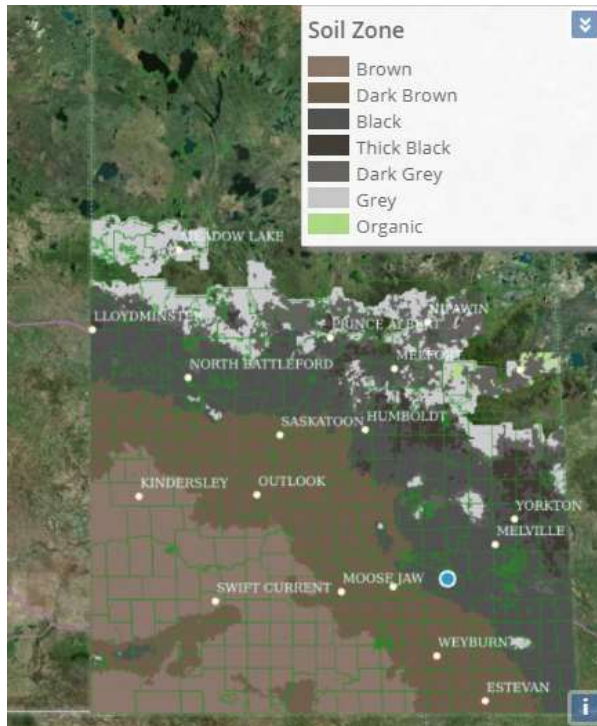
Results: Barley

	F value	Pr(>F)
julianSeedDate	7.97	0.005
julianSeedDate^2	2.74	0.098
grainRisk	7.08	< 0.001
julianSeedDate:grainRisk	3.97	< 0.001
julianSeedDate^2:grainRisk	3.61	< 0.001



Results: Barley

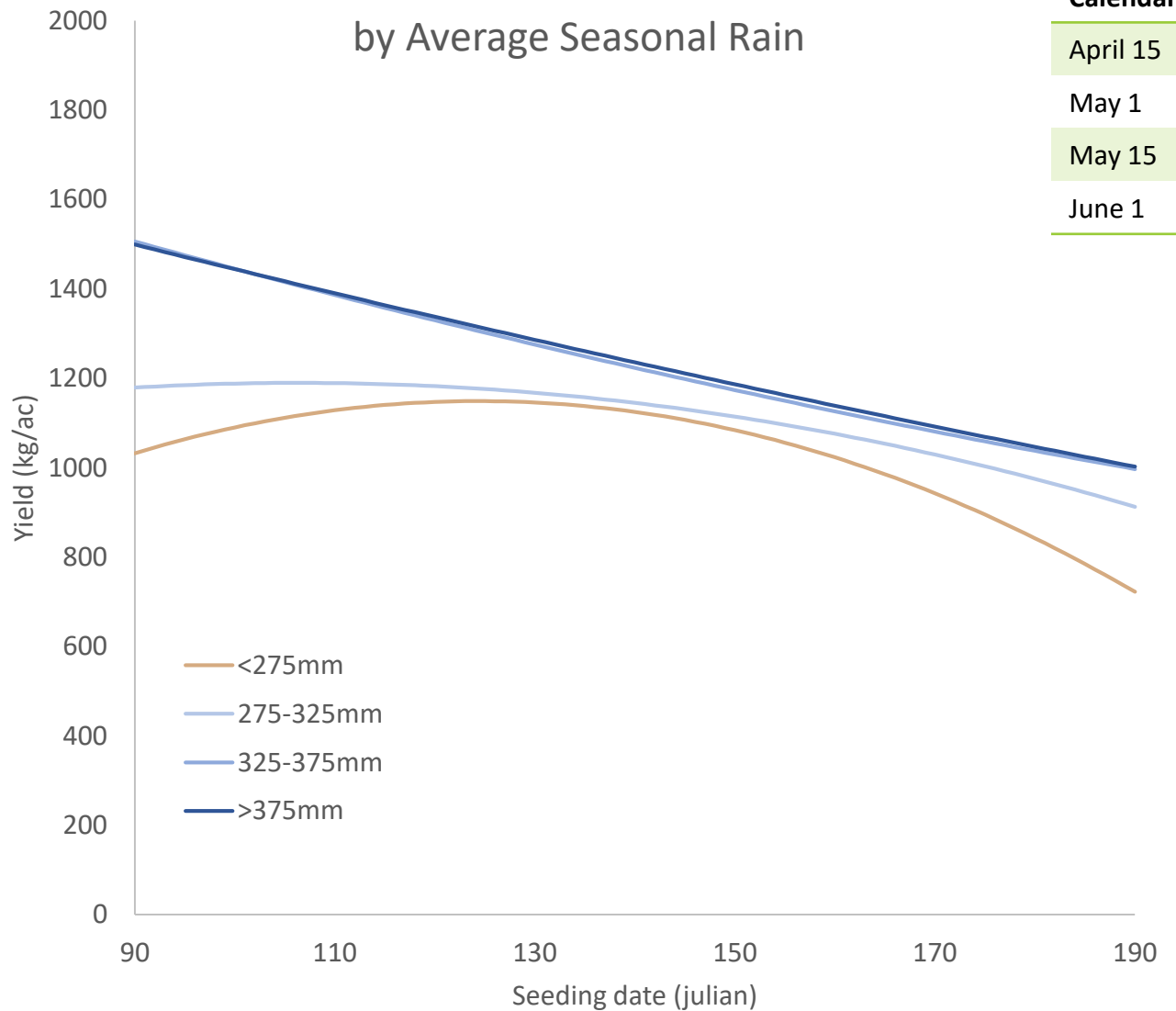
	F value	Pr(>F)
julianSeedDate	12.11	0.001
julianSeedDate^2	5.07	0.024
Soil	5.22	< 0.001
julianSeedDate:soil	5.70	< 0.001
julianSeedDate^2:soil	6.33	< 0.001



Calendar	Julian
April 15	105
May 1	121
May 15	135
June 1	152

Results: Barley

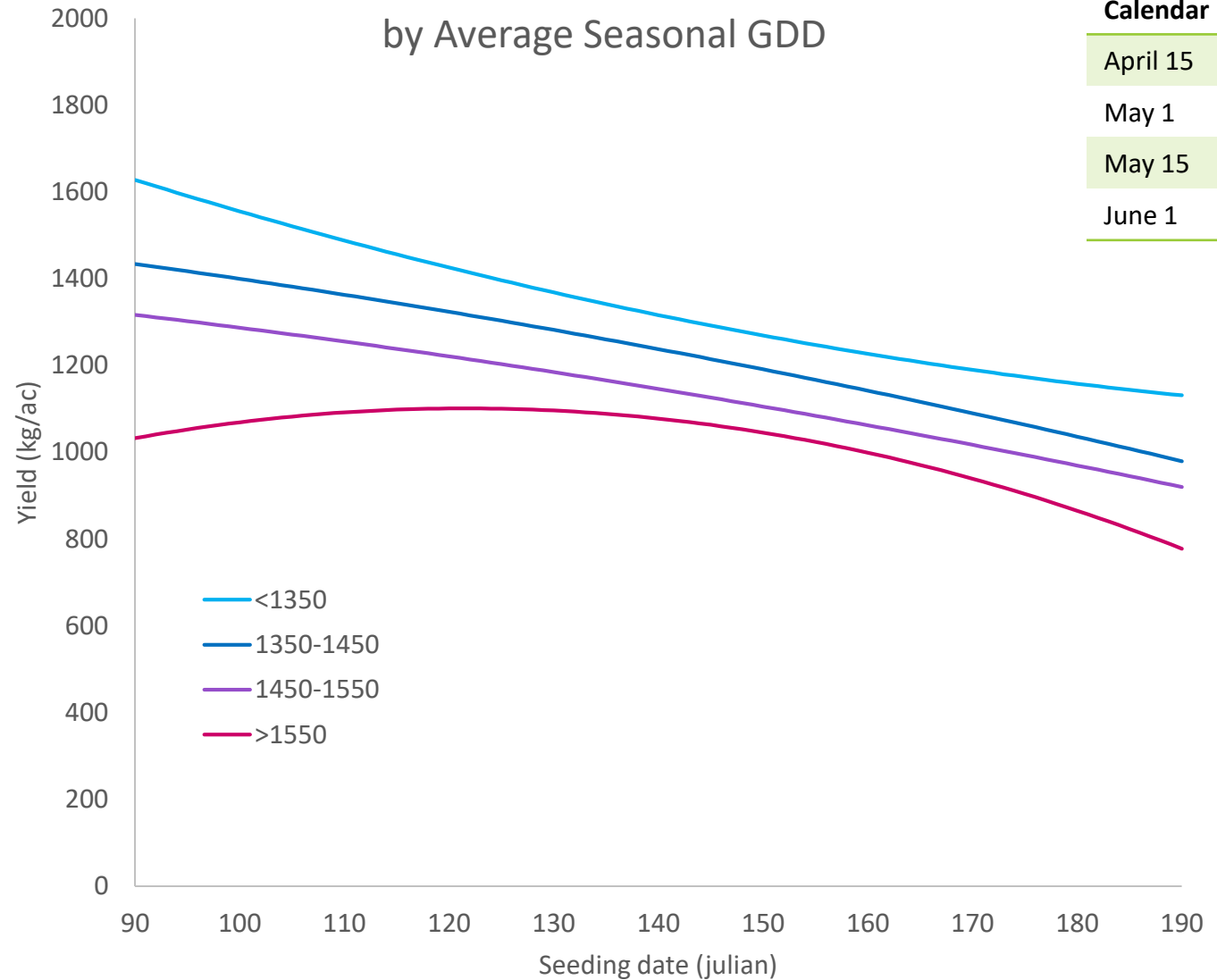
	F value	Pr(>F)
julianSeedDate	2.23	0.136
julianSeedDate^2	8.40	0.004
avgSeasonRain	9.67	< 0.001
julianSeedDate:avgSeasonRain	7.99	< 0.001
julianSeedDate^2:avgSeasonRain	7.24	< 0.001



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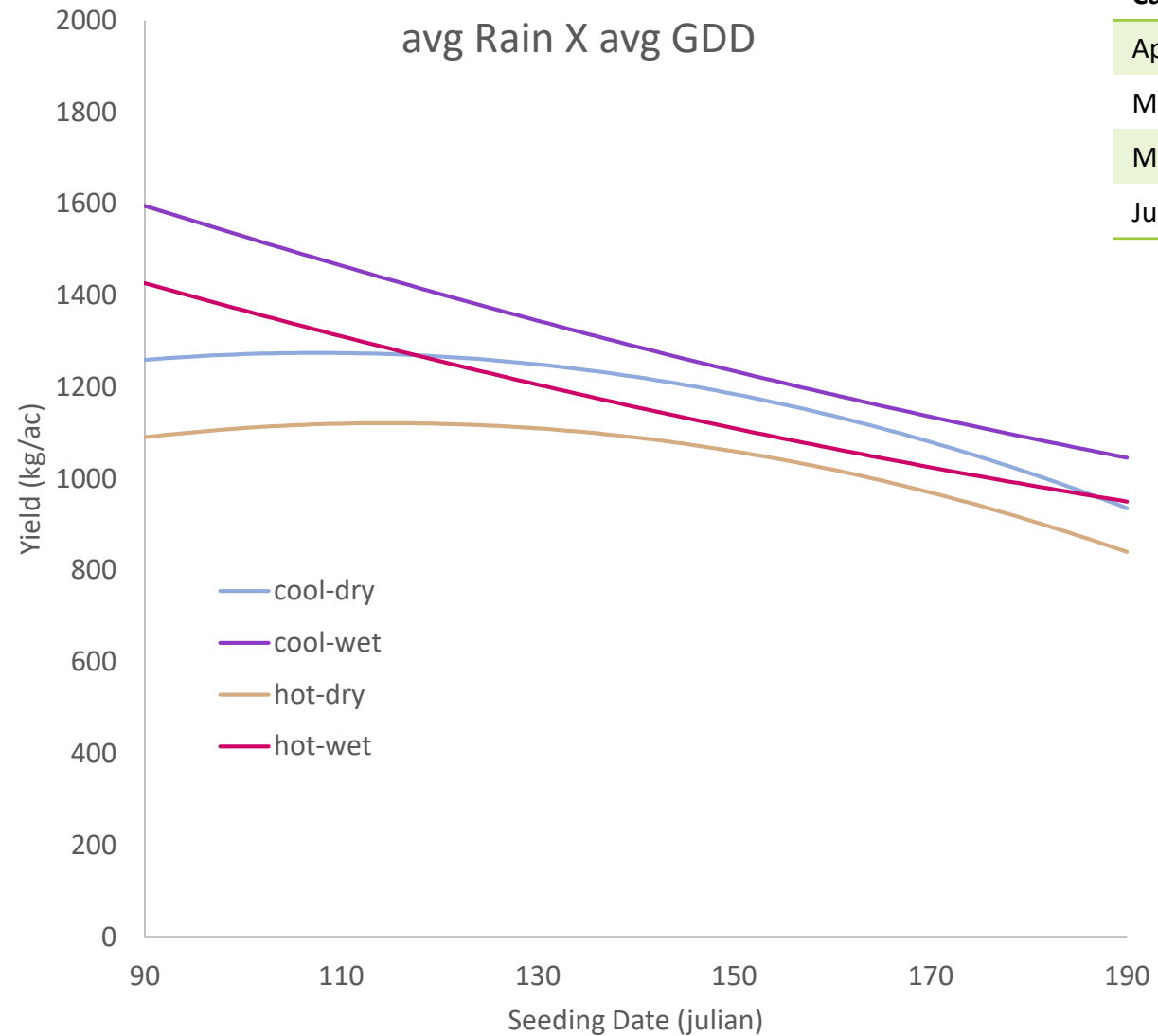
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	F value	Pr(>F)
julianSeedDate	0.07	0.797
julianSeedDate^2	3.26	0.071
avgSeasonGDD	6.02	< 0.001
julianSeedDate:avgSeasonGDD	4.48	0.004
julianSeedDate^2:avgSeasonGDD	3.97	0.008



Results: Barley

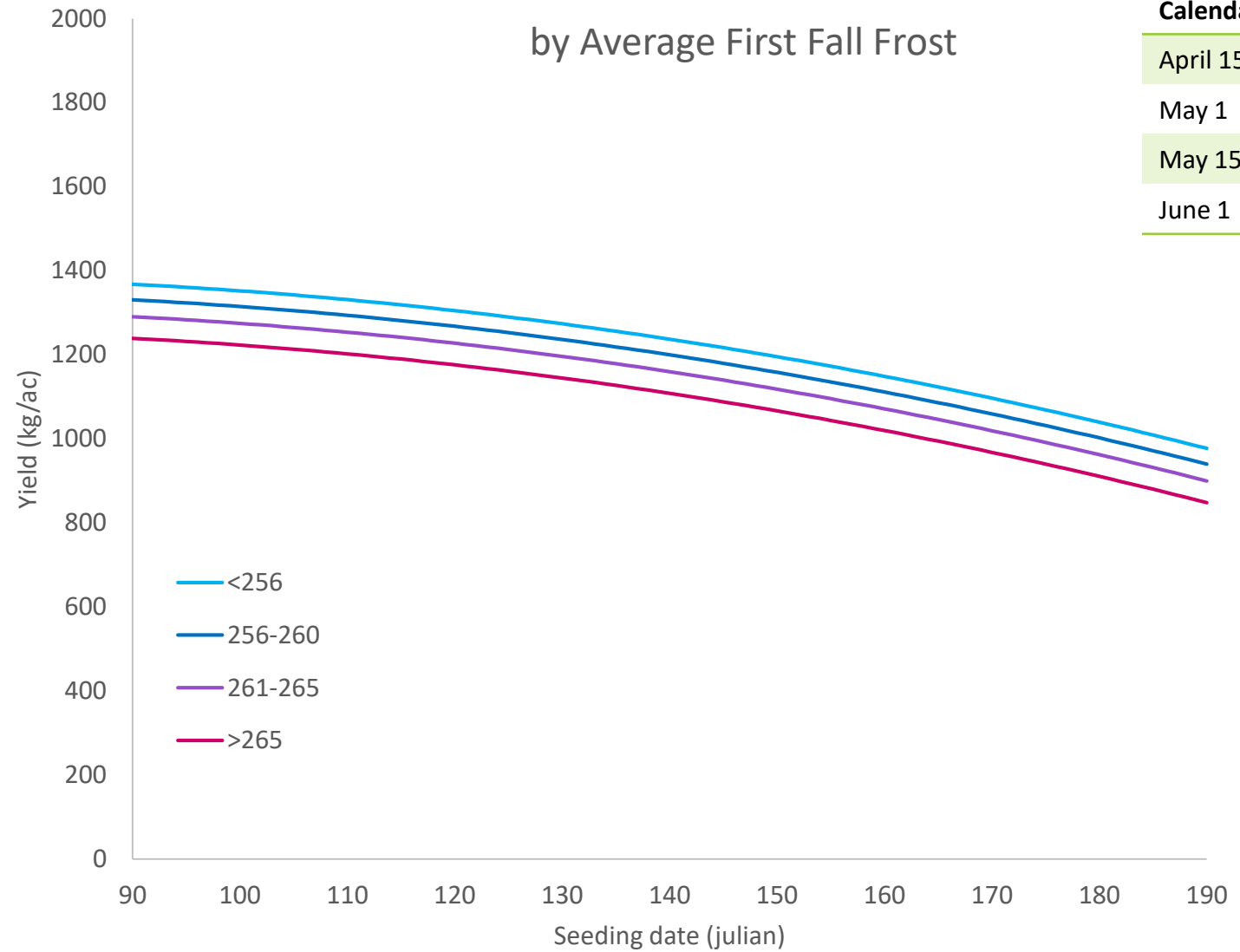
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julianSeedDate	0.25	0.617
julianSeedDate^2	5.20	0.023
avgSeasonRain	23.11	< 0.001
avgSeasonGDD	31.34	< 0.001
julianSeedDate:avgSeasonRain	18.34	< 0.001
ljulianSeedDate^2:avgSeasonRain	15.51	< 0.001
julianSeedDate:avgSeasonGDD	7.24	0.007



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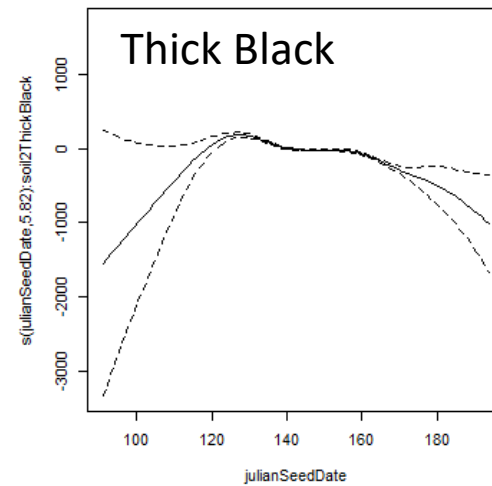
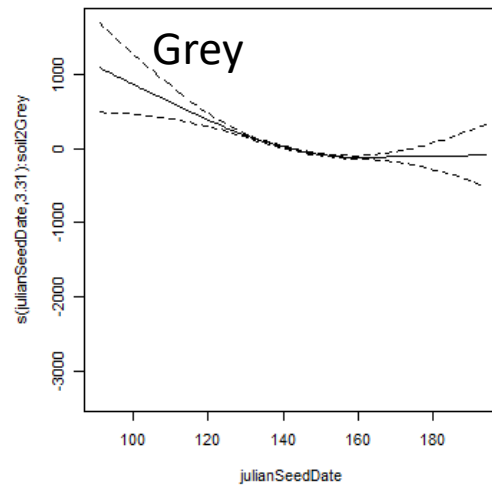
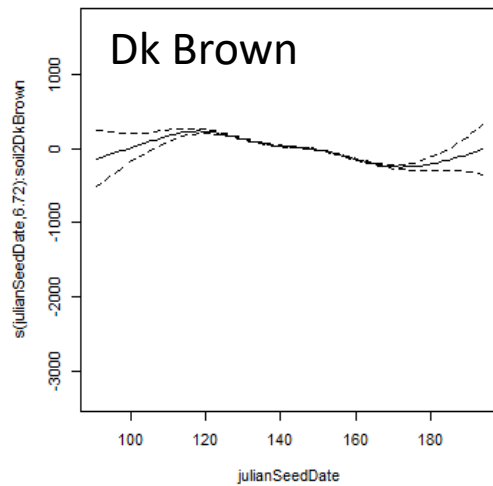
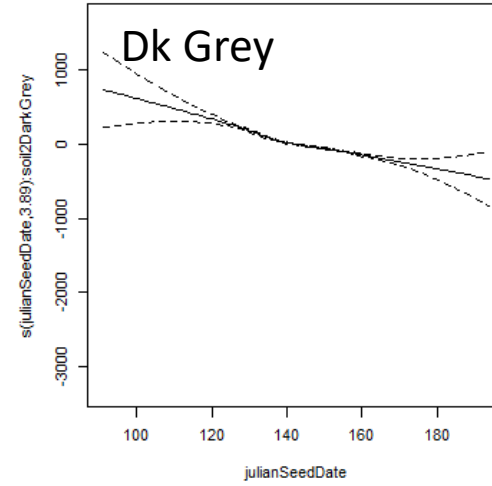
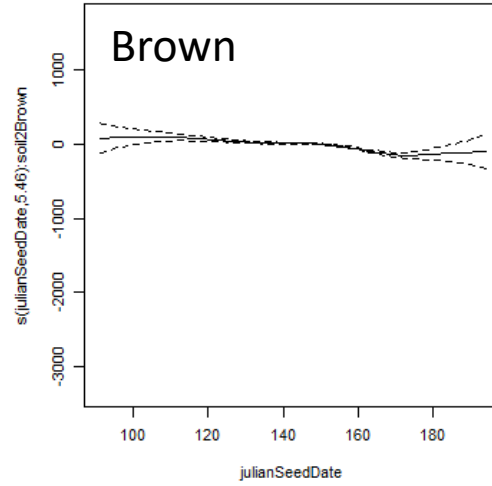
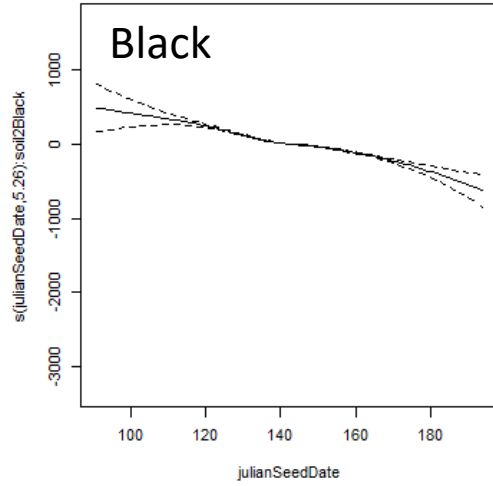
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	F value	Pr(>F)
julianSeedDate	2.01	0.156
julianSeedDate^2	10.24	0.001
avgFFFF	12.81	< 0.001



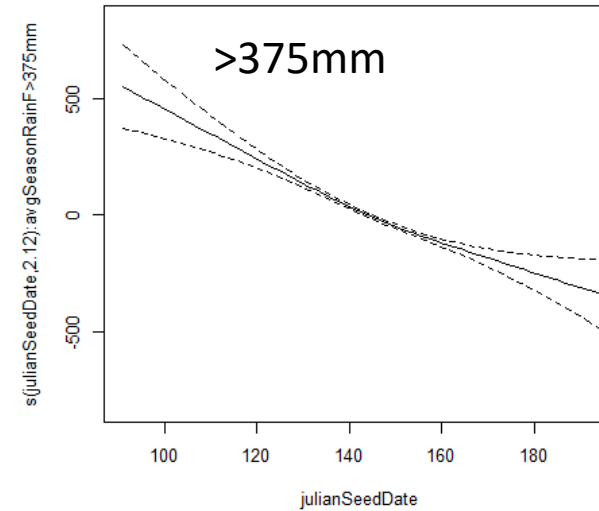
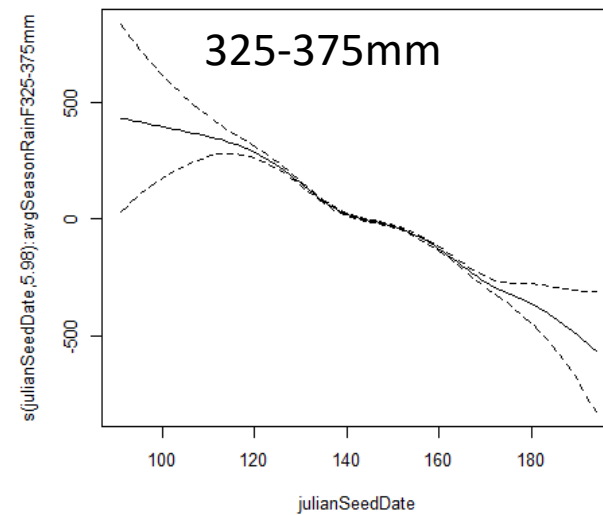
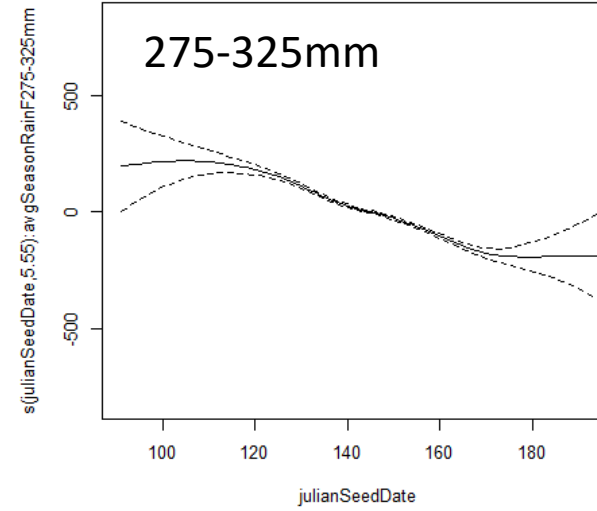
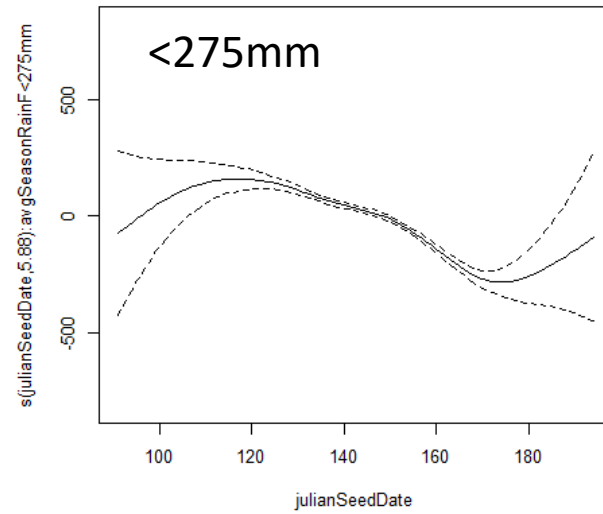
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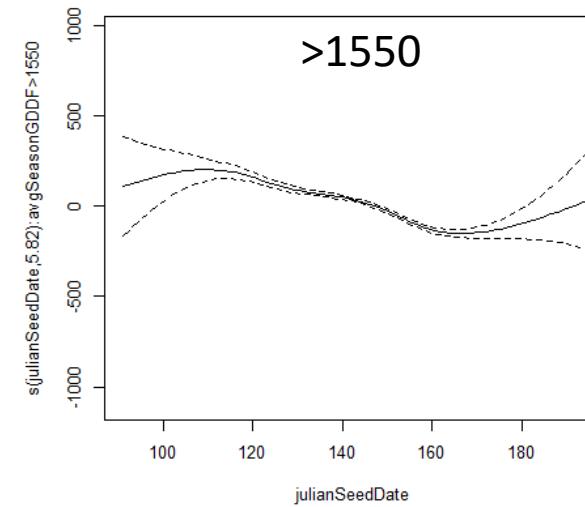
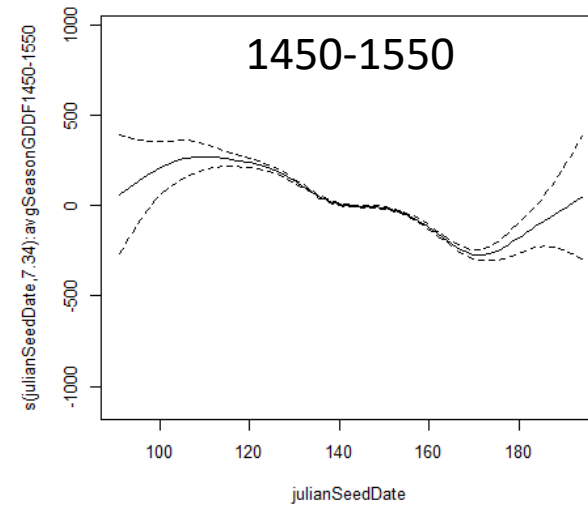
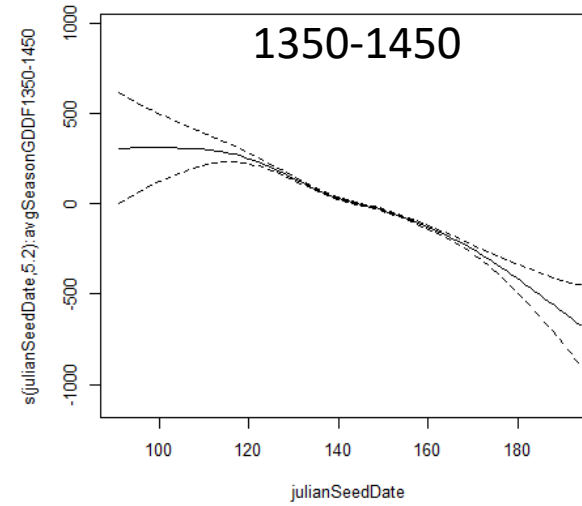
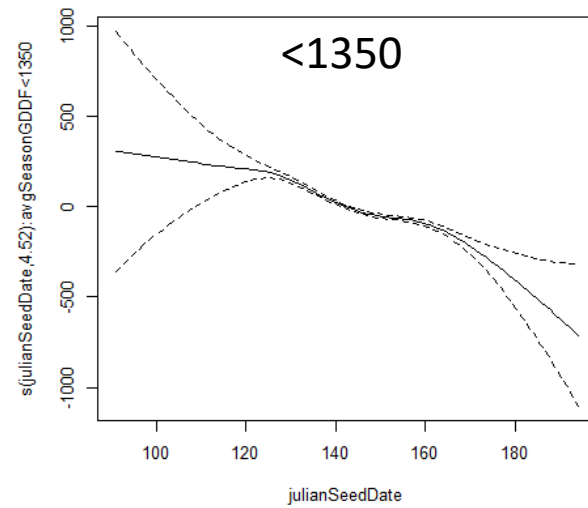
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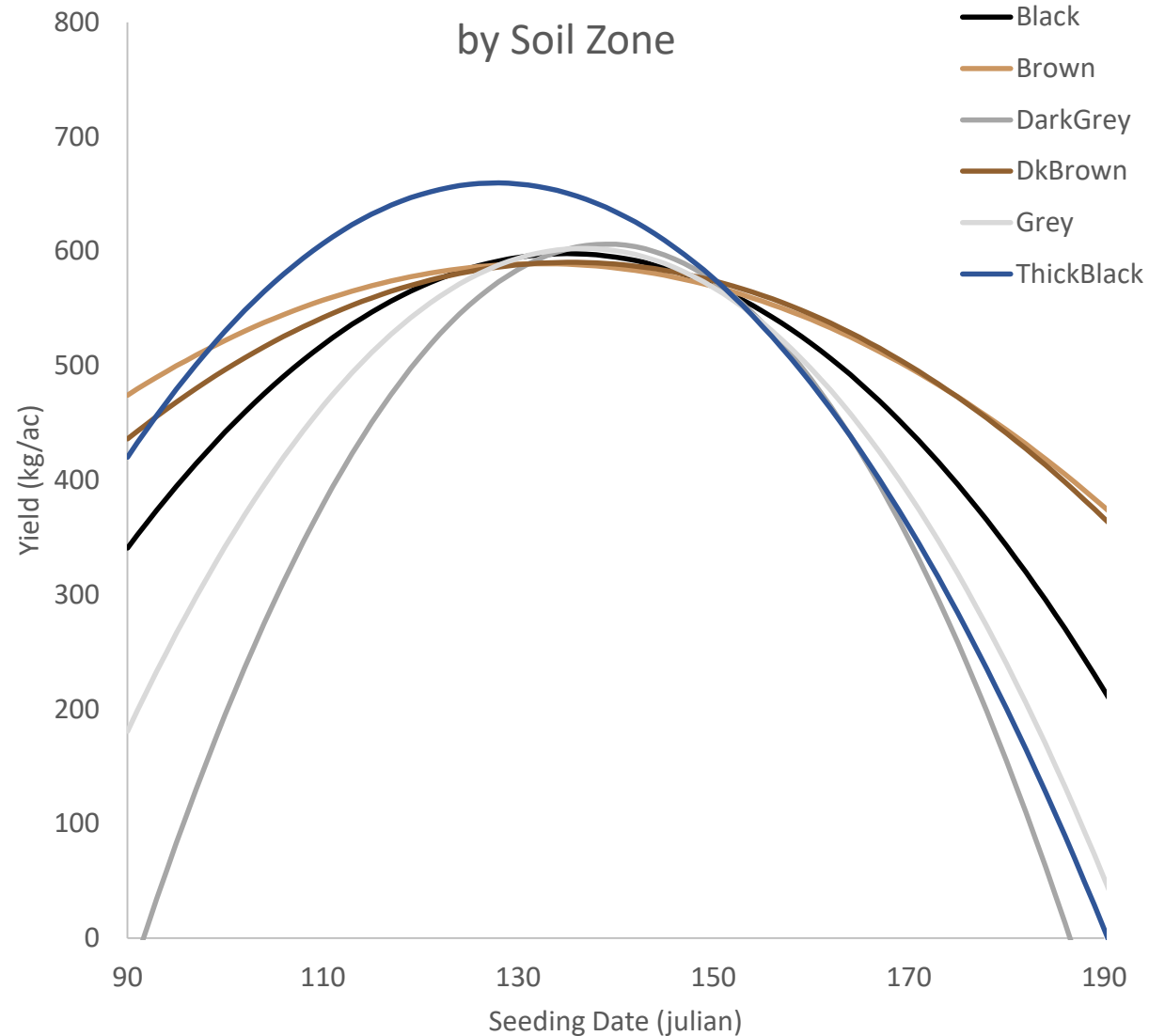
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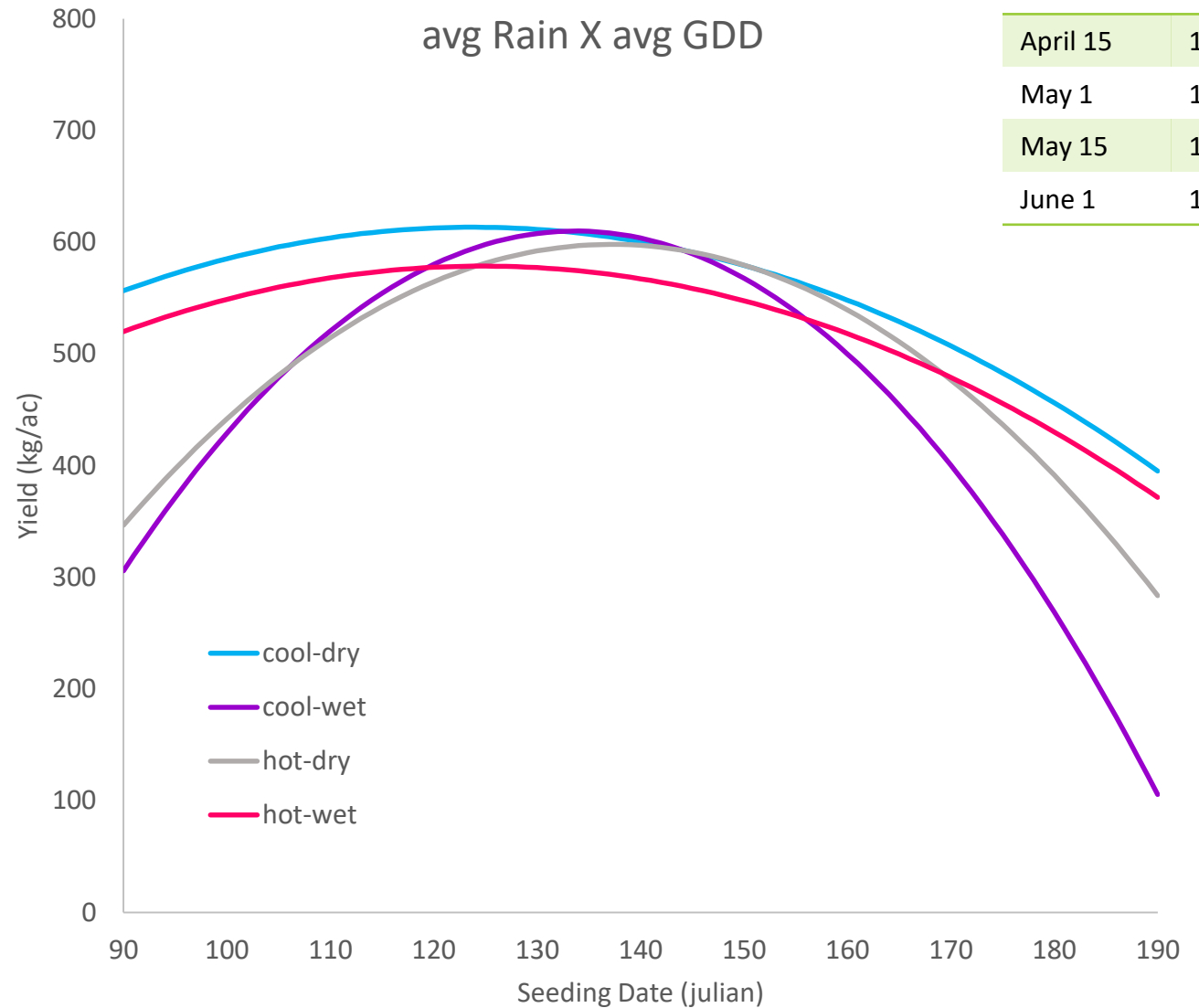
	F value	Pr(>F)
julianSeedDate	25.56	< 0.001
julianSeedDate^2	29.25	< 0.001
Soil	2.21	0.051
julianSeedDate:soil	2.46	0.031
julianSeedDate^2:soil	2.72	0.018



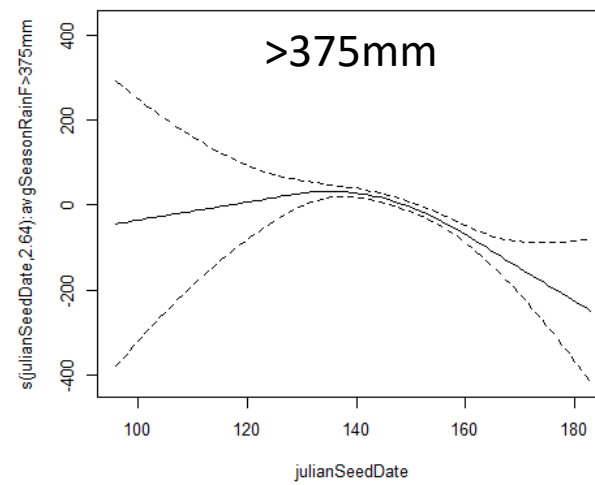
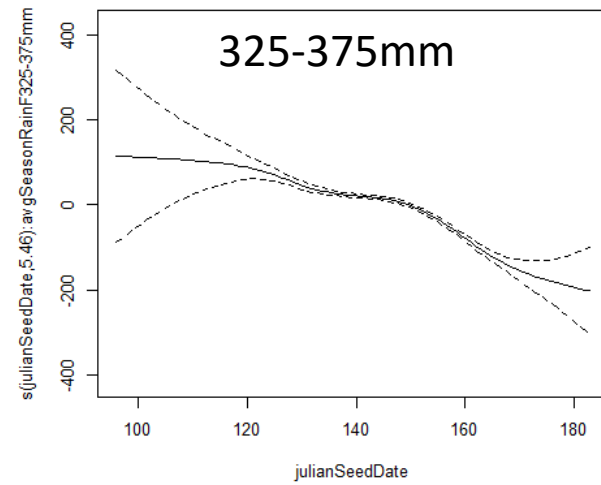
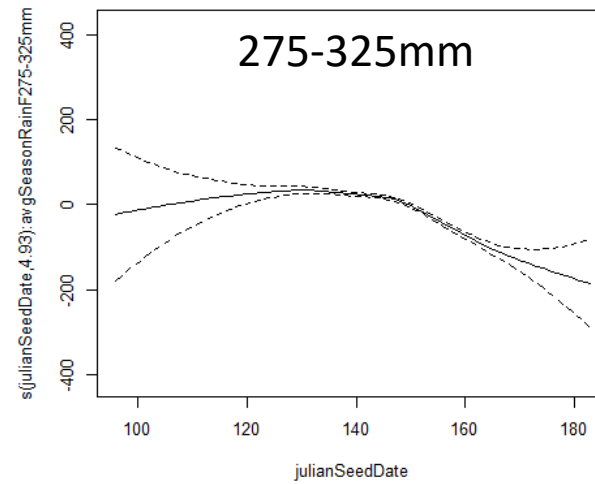
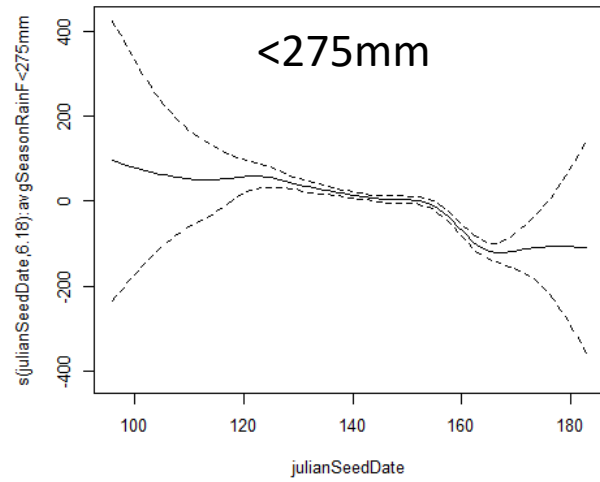
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	F value	Pr(>F)
julianSeedDate	48.16	< 0.001
julianSeedDate^2	58.28	< 0.001
avgSeasonRainF2	0.53	0.465
avgSeasonGDDF2	0.44	0.504
julianSeedDate:avgSeasonRain	0.67	0.411
julianSeedDate^2:avgSeasonRain	0.89	0.344
julianSeedDate:avgSeasonGDD	0.70	0.400
julianSeedDate^2:avgSeasonGDD	0.97	0.323
AvgSeasonRain:avgSeasonGDD	11.63	0.001
julianSeedDate:avgSeasonRain:avgSeasonGDD	12.55	< 0.001
julianSeedDate^2:avgSeasonRain:avgSeasonGDD	13.33	< 0.001



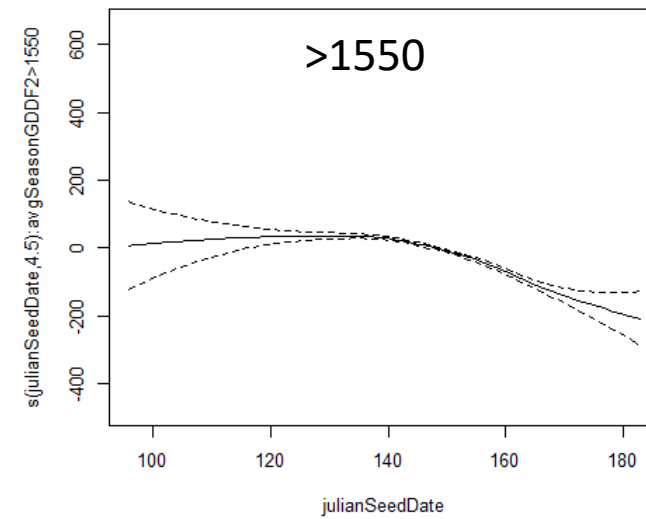
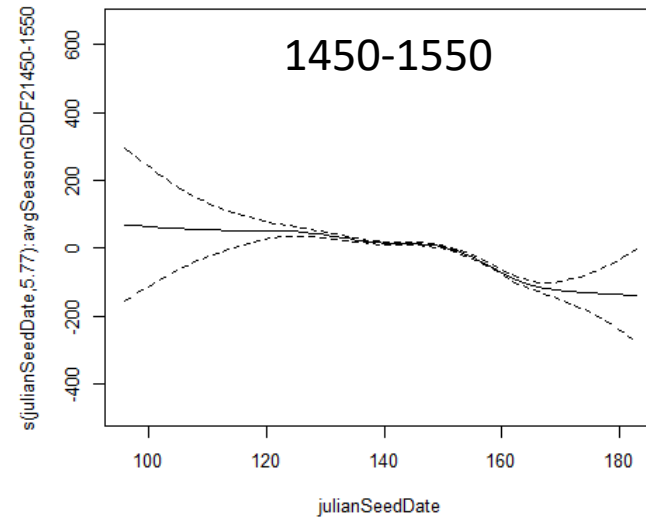
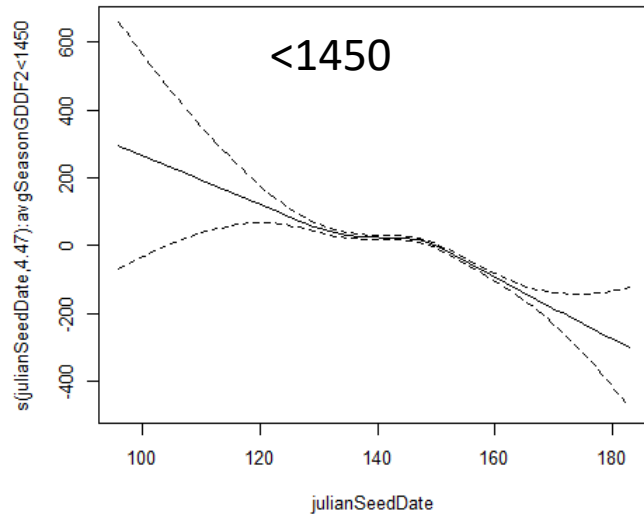
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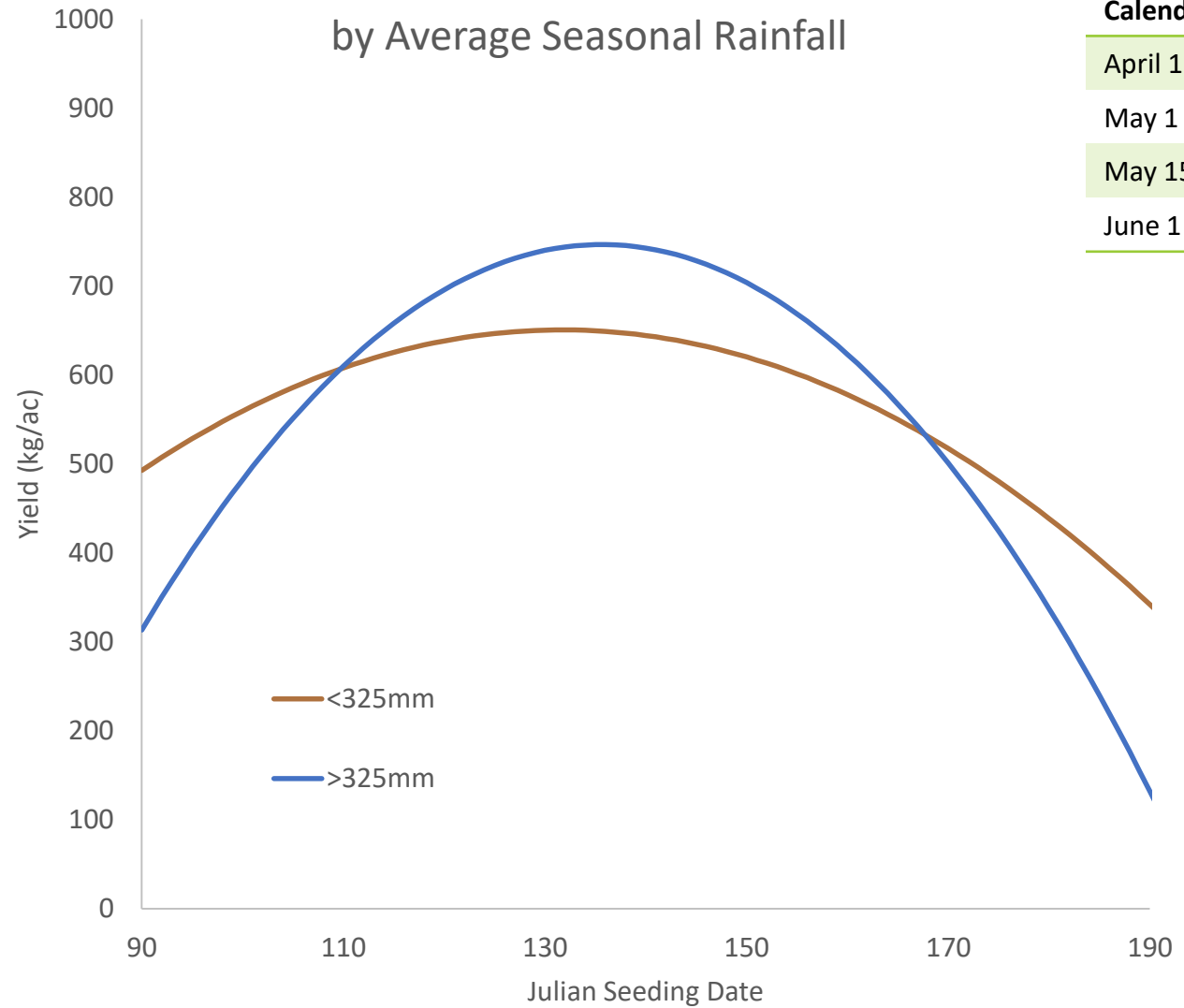
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Results: Soybeans

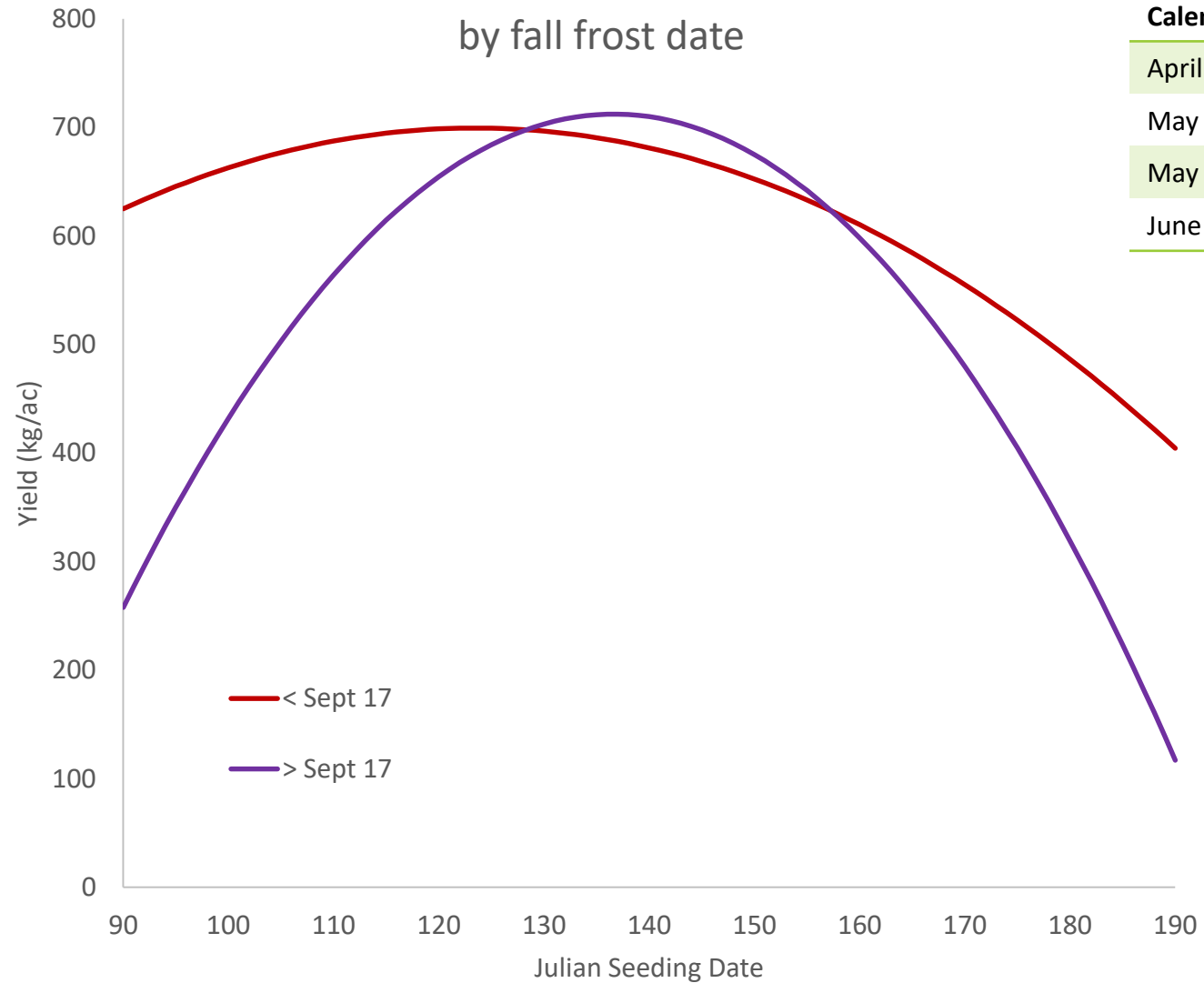
	F value	Pr(>F)
julianSeedDate	26.22	< 0.001
julianSeedDate^2	30.13	< 0.001
avgSeasonRain	3.76	0.052
julianSeedDate:avgSeasonRain	4.45	0.035
julianSeedDate^2:avgSeasonRain	4.81	0.028



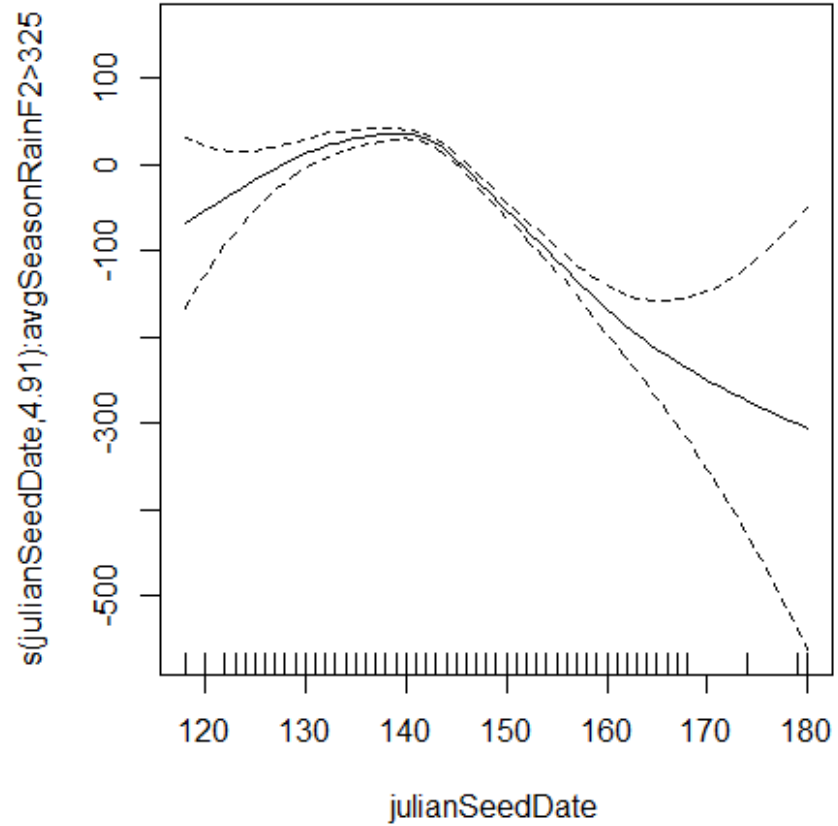
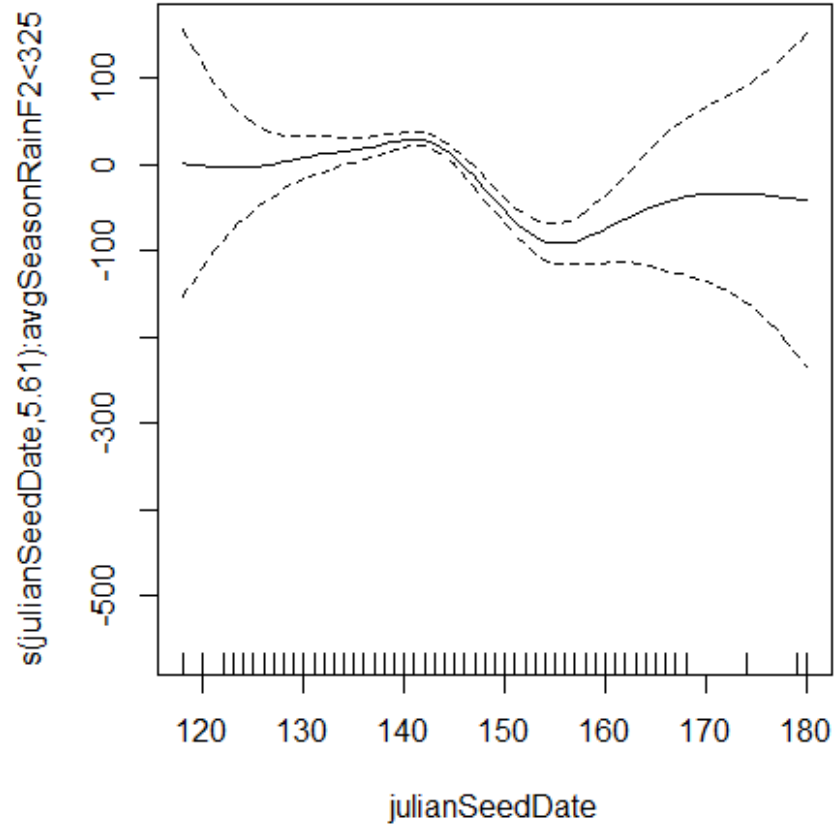
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Results: Soybeans

	F value	Pr(>F)
julianSeedDate	20.86	< 0.001
I(julianSeedDate^2)	24.28	< 0.001
avgFFFF	6.36	0.012
julianSeedDate:avgFFFF2	6.58	0.010
I(julianSeedDate^2):avgFFFF2	6.68	0.010



Results: Soybeans



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Stay tuned for more results...

- Also, analysis of crop rotation effects with the same data set