Identification and Utilization of Novel Sources of Resistance to Soil Borne Pathogens in Wheat

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Presented at CAIGE meeting, March 17, 2014, by Dr Julie M Nicol

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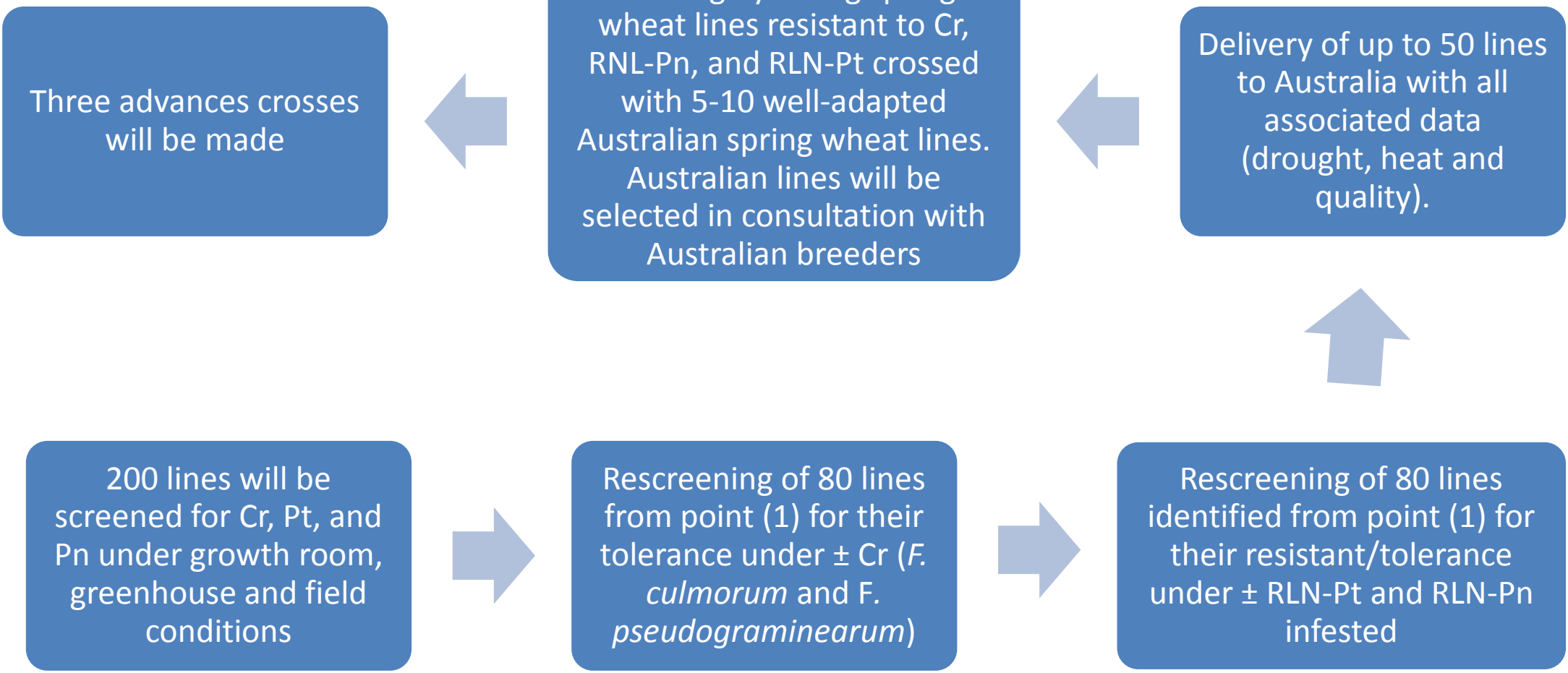
Spring Wheat Screening



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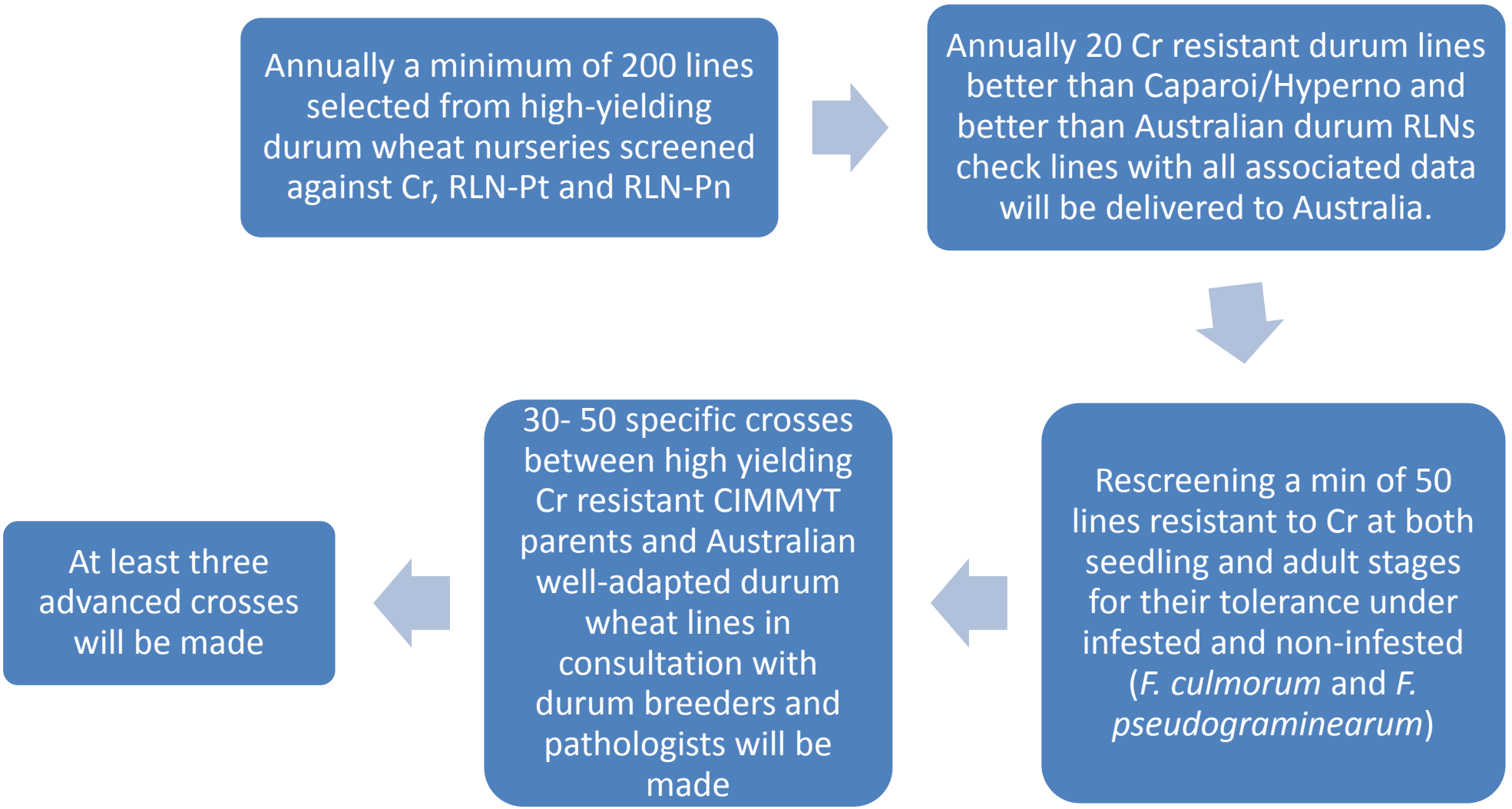
Durum Wheat Screening



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Landraces Screening

Based on the FIGS analysis, 500 durum and bread wheat landraces for Cr and each nematode (RLN-Pt and RLN-Pn) will be screened

20-30 resistant lines will be further screened for Cr (*Fusarium culmorum*) APR under field conditions in Yozgat infested site and under greenhouse in three replicates in Eskisehir

30-50 further crosses between this promising landraces and Australian nominated durum and spring wheat germplasm in consultation with Australian breeders (both bread and durum wheat) made

Originating F1 from simple crosses and F2s from back or top-crosses will be sent to Australia

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Progress in understanding the chromosomal location of resistance to *P. thornei*

	P. thornei resistance	Chromosomal location							Group	Source actively used in breeding programs
		1	2	3	4	5	6	7		
1	Sythethic hexaploid CPI 133872		DS				DS, AL, AS		QDPI - Zwart et al.	limited LRC
2	2 middle eastern landraces - Iraq 43 (AUS4926) and Morocco 426 (AUS13124)	B	BS	B			DS		CSIRO - Schmidt et al.	unknown
3	GS50a wheat line						DS		CSIRO - Lagudah et al.	extensively in Northern Region and CIMMYT Int.
4	CIMMYT synthetic hexaploid CROC_1/AE.SQUARROSA (224)//OPATA	B							CSIRO/CIMMYT - McIntyre et al.	moderately in CIMMYT Int.
				B						
					D					
5	CIMMYT Iraqui landrace AUS4930 7.2	B							CSIRO/CIMMYT - McIntyre et al.	extensively in CIMMYT Int. and to a limited degree in Southern Region
		B								
			B							
							D			

Toktay et al., 2006 Genome 49: 1-5. Joint collaboration Turkey, CSIRO & CIMMYT

Mapping populations – linked with AWBMMP GA

More than DH individuals of an advanced synthetic derivative from CIMMYT Mexico CROC_1/AE.SQUARROSA (224)//OPATA (CID 72726; SID 531; SH: CMBW91Y00935S-80Y-11KBY-1KBY-010M-1Y-2M-0Y-0SY) x Janz which has resistance to both RLN-Pt and CR.

- Furthermore several other valuable disease traits could be explored (FHS, CR, YS, BP, SEPT).

- This population has been partially mapped for RLN – Pt resistance two resistance loci located on chromosomes 1B and 3B (Toktay et al., 2006 Genome. 49: 1-5).

- This population belongs to CIMMYT and GRDC and can be utilised without restriction for this project.

- Seed has been increased and was screened in 2011 & 2012 in Turkey for RLN & CR. Phenotypic data and DNA have been delivered to AWBMMP in 2013.

Other new mapping populations are planned for SBP as part of the new project

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GENETIC MECHANISMS OF NOVEL RESISTANCES TO CR & RLNs IN COLLABORATION WITH AUSTRALIAN PARTNERS IDENTIFIED

Genetic dissection of mechanisms of resistances to Cr (both *F. culmorum* and *F. pseudograminearum*), and both RLN-Pt and RLN-Pn in collaboration with Australian partners identified.

Objective: this will result in identification of new sources of resistance and development effective selection tools for accelerated germplasm development with resistances to Cr and RLNs.

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Association Mapping in CIMMYT's Winter Wheat and Spring Wheat

Studies Objectives:

1. identify quantitative trait loci (QTL)/genes conferring resistance against the cereal cyst nematode *Heterodera filipjevi* in winter wheat (This is collaborative project between CIMMYT and Bonn Uni)

1. identify quantitative trait loci (QTL)/genes conferring resistance against the cereal cyst nematode *Heterodera avenae,* Crown Rot, and the root lesion nematodes *(P. neglectus* and *P. thornei* in spring wheat (This is collaborative project between CIMMYT-TURKEY and GRDC)

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Chromosome location, *P* value and R^2 and number of significantly associated SNP markers with cereal cyst nematode *Heterodera filipjevi* resistance

Marker	CHR	Pos	P- F value	P-LOD	P- FDR	P-value	R2	Gene-trait value
RAC875_c13116_943	2A	64,3-	12,59	3,35	0,00164	0,00045	8,5	-3,04
Tdurum_contig10380_87	2B	74,9	16,72	4,26	0,00056	0,00006	12,1	4,36
Excalibur_c18966_804	2B	113,6	10,65	2,91	0,00164	0,00122	6,9	-2,80
Tdurum_contig12008_803	3B	6.14	13,75	3,61	0,00024	0,00025	8,87	3,11
wsnp_Ex_c55245_57821389	4A	53,3	10,97	2,98	0,00164	0,00104	7,5	2,77
Tdurum_contig 82236_117	4A	155,5	10,23	2,82	0,00164	0,00152	7,6	3,35
Excalibur_c78724_434	5B	158,7	11,29	3,06	0,00164	0,00087	8,1	3,65
Bobwhite_rep_c66630_331	7B	79,1	10,20	2,81	0,00164	0,00154	7,5	-3,31
BS00066862_51	Un		15,68	4,03	0,00056	0,00009	11,3	-3,79
Ex_c5594_2818	Un		12,20	3,26	0,00164	0,00055	9,0	-2,91
BS00090309_51	Un		11,10	3,02	0,00164	0,00096	8,0	-4,36
wsnp_JD_c13384_13343159	Un		10,12	2,79	0,00164	0,00161	7,2	-2,66
wsnp_Ex_c1440_2764867	Un		10,09	2,79	0,00164	0,00164	7,1	3,37

- **13** novel QTL loci associated with *H. filipjevi* development were identified: **7** QTL associated with *H. filipjevi* resistance and **6** QTL associated with *H. filipjevi* susceptibility
- **4** QTL regions (2A, 3B, 4A and 7B) were same as other CCN *H. avenae* resistance had been detected in previous studies

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Chromosome position, *P* value, R^2, FDR (*q*), allele number and frequency of significant DArT markers associated with resistance to *Heterodera avenae* in Mex Spring wheat germplasm

Trait	DArT	chr	pos	*P*	*q*	R^2	Allele	Frequency
H. avenae	wPt-731843	1A	16.7	0.0169	0.0188	0.054	0	0.81
H. avenae	wPt-664586	1A	17.5	0.0304	0.0313	0.045	0	0.83
H. avenae	wPt-730408	1A	74.5	0.0087	0.0125	0.071	0	0.93
H. avenae	wPt-671653	1D	67.2	0.0086	0.0094	0.066	0	0.46
H. avenae	wPt-4131	5A	37.9	**0.0027**	0.0063	0.087	0	0.54
H. avenae	wPt-5120	5B	29.4	0.0110	0.0156	0.062	0	0.78
H. avenae	wPt-2373	5B	155.4	0.0315	0.0344	0.045	0	0.68
H. avenae	wPt-1210	5D	4.4	0.0469	0.0469	0.038	1	0.81
H. avenae	wPt-3247	6A	107.8	0.0336	0.0375	0.045	1	0.69
H. avenae	wPt-743099	6B	65.8	**0.0027**	0.0031	0.086	0	0.93
H. avenae	wPt-672075	7A	10.4	0.0250	0.0255	0.053	0	0.74

P values in **bold** correspond to markers that survived the Bonferroni test

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Chromosome position, *P* value, R^2, FDR (*q*), allele number and frequency of significant DArT markers associated with resistance to *Pratylenchus neglectus*

Trait	DArT	chr	pos	*P*	*q*	R^2	Allele	Frequency
P. neglectus	wPt-8016	1A	125.4	0.0175	0.0250	0.056	1	0.62
P. neglectus	wPt-9639	1B	14.6	0.0376	0.0423	0.044	0	0.67
P. neglectus	wPt-2600	2B	58.6	0.0142	0.0212	0.059	1	0.79
P. neglectus	wPt-5672	2B	63.2	0.0276	0.0346	0.050	0	0.74
P. neglectus	wPt-1036	3A	190.2	0.0458	0.0462	0.040	0	0.56
P. neglectus	wPt-8886	3B	64.7	**0.0010**	0.0038	0.102	0	0.84
P. neglectus	wPt-4596	4A	77.6	0.0068	0.0135	0.073	0	0.81
P. neglectus	wPt-3349	4A	84.8	0.0065	0.0115	0.071	1	0.81
P. neglectus	wPt-2982	4A	84.8	0.0181	0.0269	0.056	1	0.84
P. neglectus	wPt-9196	4A	84.8	0.0346	0.0385	0.044	1	0.60
P. neglectus	wPt-7807	4A	87.9	0.0084	0.0192	0.070	0	0.39
P. neglectus	wPt-6502	4A	89.9	**0.0010**	0.0096	0.102	1	0.84
P. neglectus	wPt-730913	4A	93.1	0.0070	0.0173	0.071	1	0.81
P. neglectus	wPt-5578	4A	93.2	0.0406	0.0442	0.041	1	0.70
P. neglectus	wPt-8167	4A	94.3	**0.0010**	0.0058	0.102	0	0.84
P. neglectus	wPt-8271	4A	94.3	0.0010	0.0077	0.102	0	0.84
P. neglectus	wPt-9645	4A	94.6	0.0362	0.0404	0.043	1	0.75
P. neglectus	wPt-9183	4A	95.7	**0.0008**	0.0019	0.107	0	0.84
P. neglectus	wPt-1155	4A	98.4	0.0069	0.0154	0.072	0	0.66
P. neglectus	wPt-4424	4A	98.4	0.0150	0.0231	0.060	0	0.67
P. neglectus	wPt-9642	6B	55	0.0198	0.0288	0.053	1	0.99
P. neglectus	wPt-6208	6B	66	0.0270	0.0327	0.052	0	0.62
P. neglectus	wPt-7151	7A	10.5	0.0479	0.0481	0.042	0	0.79
P. neglectus	wPt-3992	7A	85.9	0.0218	0.0308	0.052	1	0.75
P. neglectus	wPt-664400	7D	116.9	0.0321	0.0365	0.046	1	0.98

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Chromosome position, *P* value, R^2, FDR (*q*), allele number and frequency of significant DArT markers associated with resistance to *Pratylenchus thornei*

Trait	DArT	chr	pos	*P*	*q*	R^2	Allele	Frequency
P. thornei	wPt-3855	1D	21.4	0.0149	0.0184	0.057	1	0.93
P. thornei	wPt-8490	2A	28.9	0.0430	0.0447	0.046	0	0.83
P. thornei	wPt-5029	2A	46	0.0216	0.0237	0.054	1	0.82
P. thornei	wPt-742715	3B	14.2	0.0368	0.0381	0.042	1	0.79
P. thornei	wPt-744750	5B	44.5	0.0132	0.0158	0.059	1	0.81
P. thornei	wPt-1304	5B	111.7	0.0238	0.0263	0.049	0	0.94
P. thornei	wPt-7151	7A	10.5	0.0434	0.0474	0.044	0	0.79
P. thornei	wPt-6668	7A	12.4	0.0166	0.0211	0.056	1	0.63

Result of crown rot is analyzed and now in preparation

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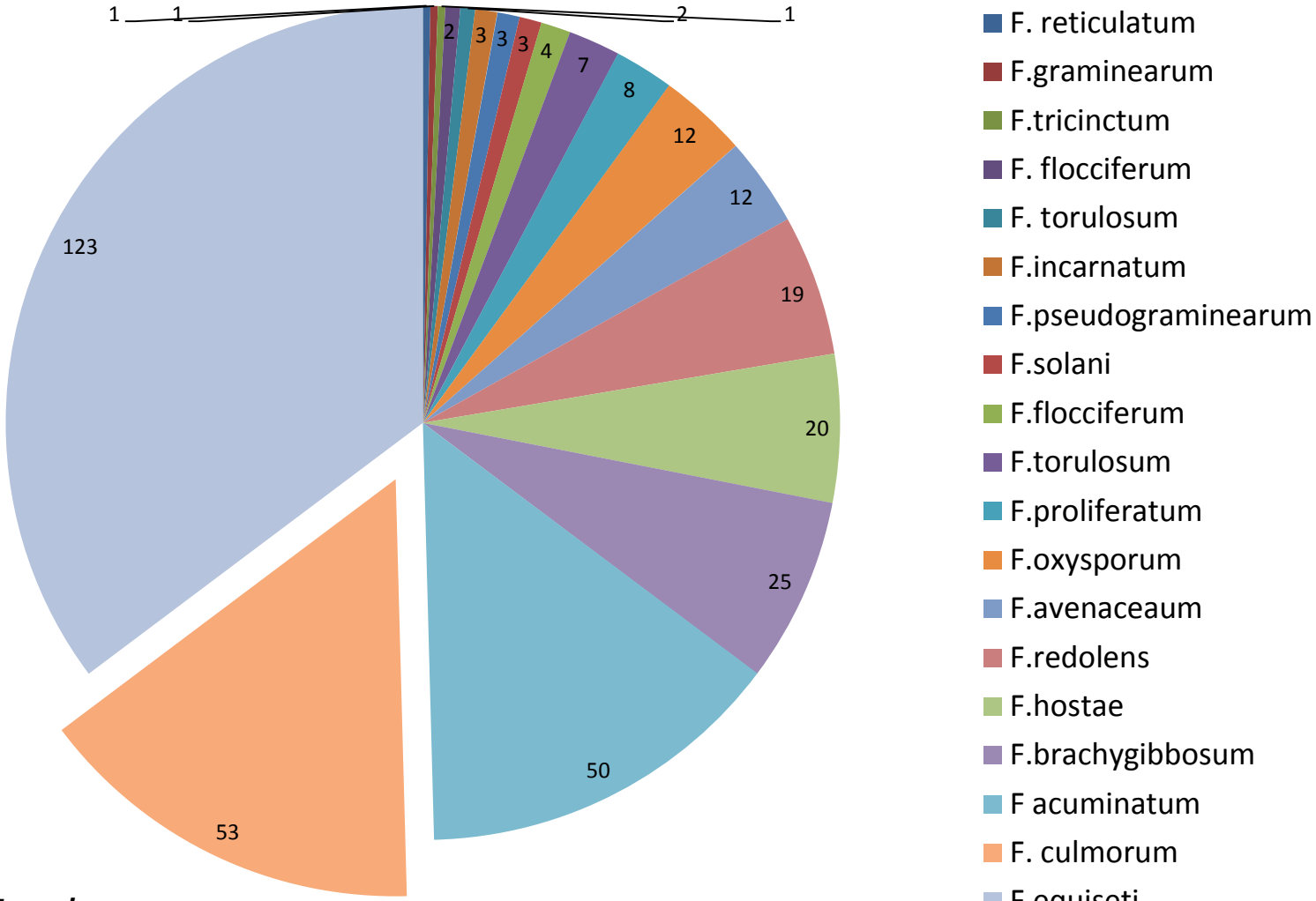
Frequency of Fusarium species found in main wheat growing regions in Turkey-2013

(This is collaborative project between CIMMYT-Turkey, Ankara Uni and WSU funded by LEAP)



F. culmorum

Total sample no: 349 collected from 6 regions of TK

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Fusarium culmorum Distribution in main wheat growing regions in Turkey – 2013

	Total samples	%
Black Sea	75	18,6
Central Anatolia	62	29
Eagean	96	13
South East	113	7

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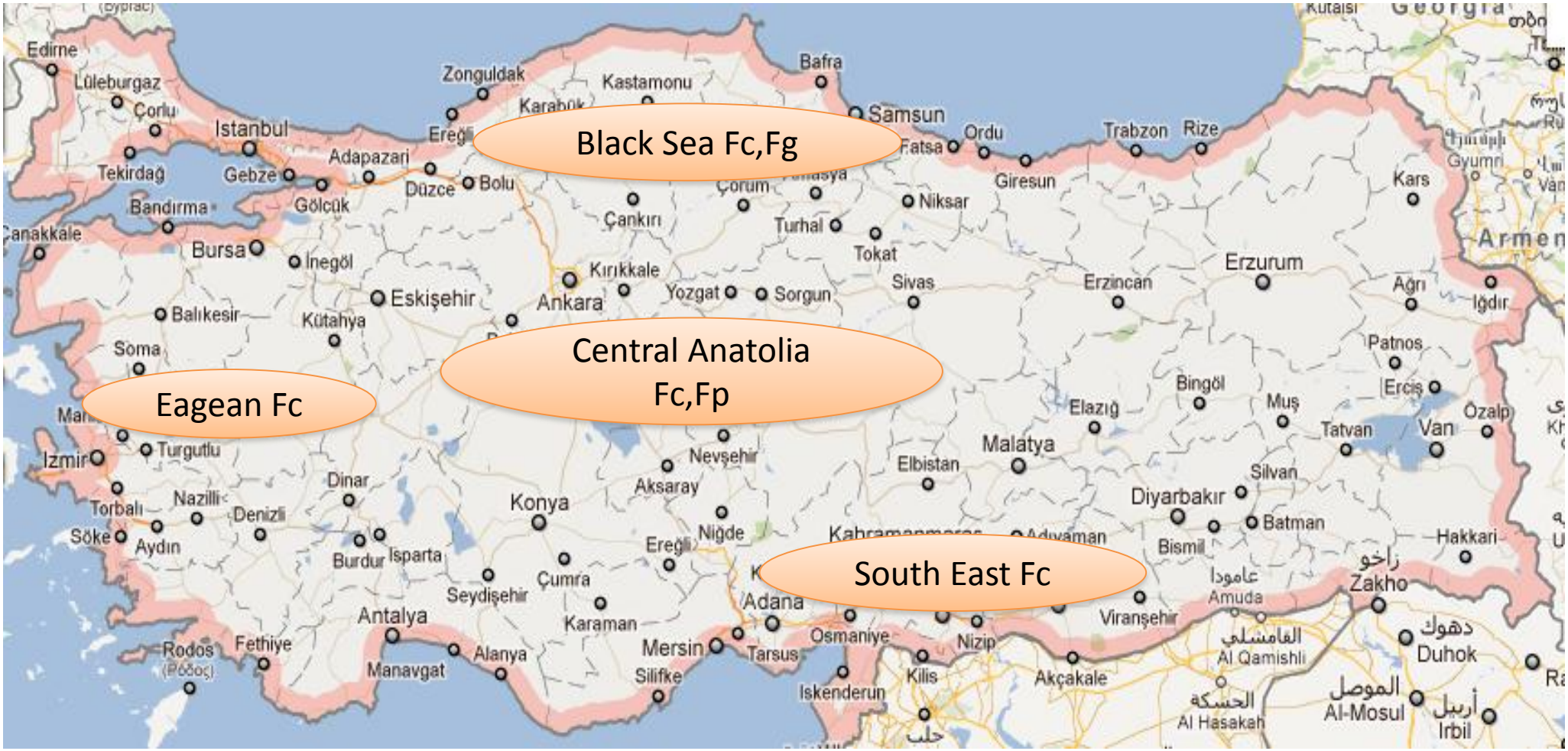
The dryland root rot pathogens found in Turkey-2013



Fc: *Fusarium culmorum*, Fp: *F. pseudograminearum*, Fg: F. graminearum

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GRDC
Grains Research & Development Corporation

REPUBLIC OF TURKEY
MINISTRY OF FOOD AGRICULTURE AND LIVESTOCK

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ÇUKUROVA ÜNİVERSİTESİ 1973

ANKARA ÜNİVERSİTESİ 1946

İLCİ TARIM HAYVANCILIK BİOGAZ ENERJİ ÜRETİM SAN. ve TİC. A.Ş.

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