Better forecasts for better decisions

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PREMIUM FOOD AND WINE FROM OUR CLEAN ENVIRONMENT

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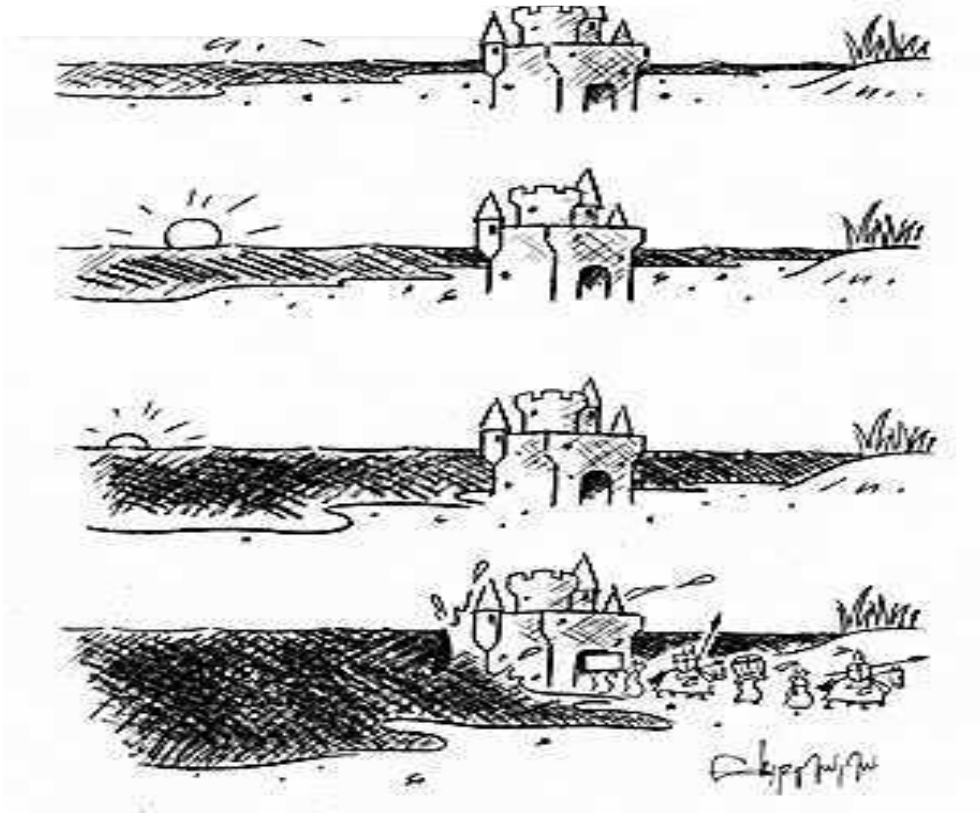

What destroyed the sand castle ? The wave or tide ?

What can we learn from the wave about future resilience and vulnerability ?

“adaptation needs to slow down and have a process that we trust”.

- “expert accounts of a distant and discontinuous future contrast strongly with the continuity anticipated by residents across their remembered pasts, lived presents, and imagined futures”

Fincher Barnett and Graham 2015

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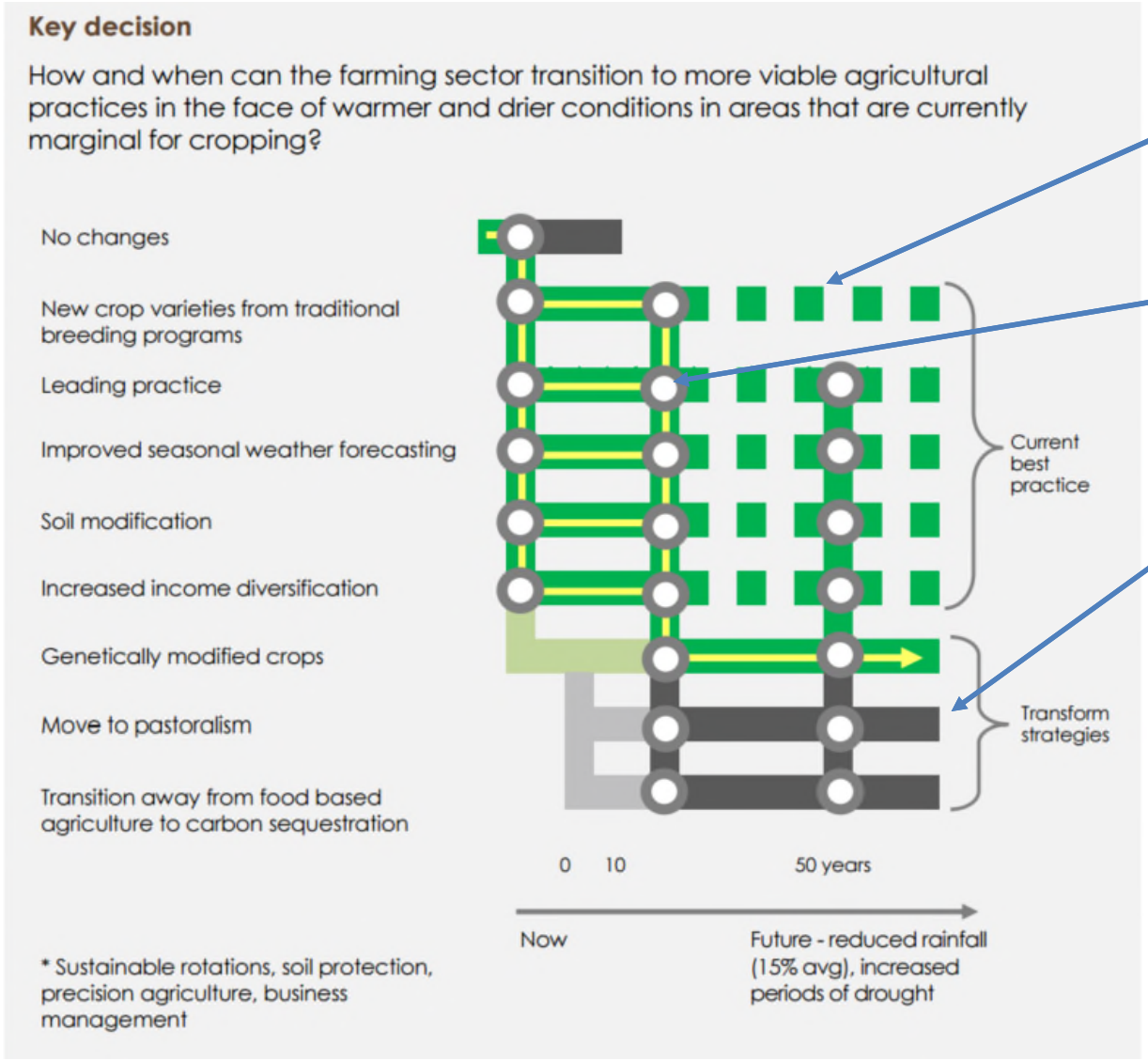
Regional CC adaptation plan for EP 2014

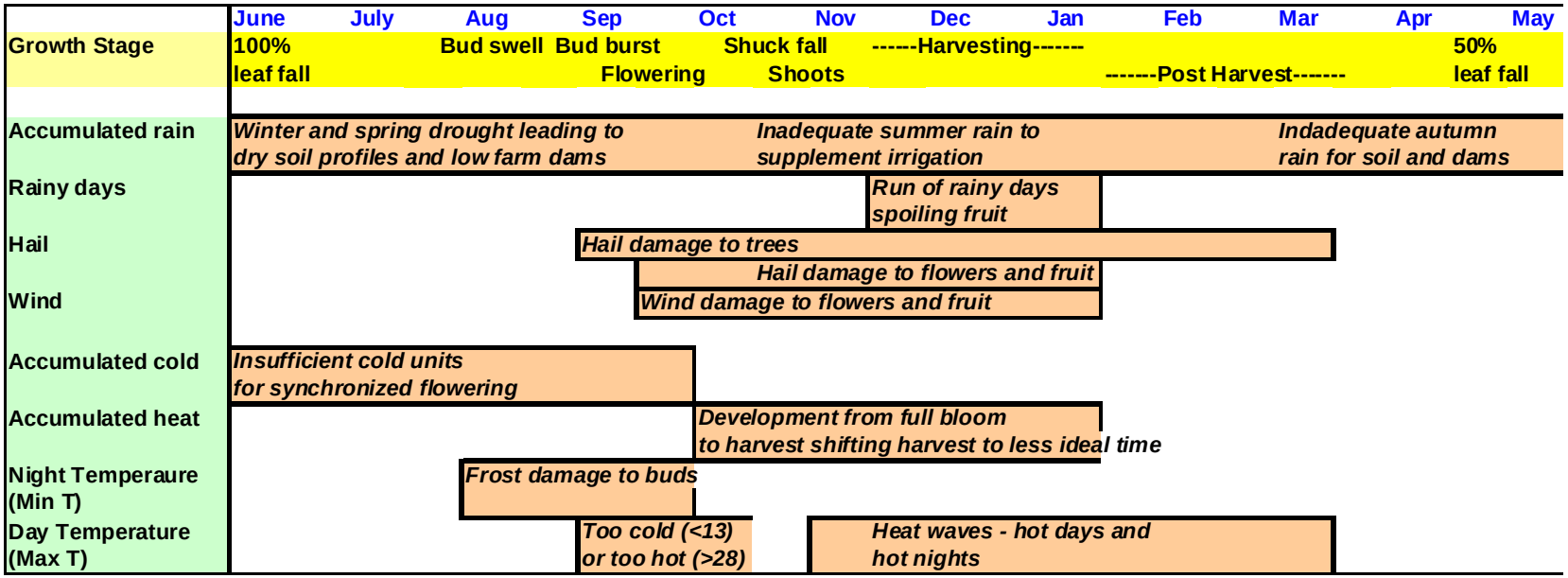


Dashed line = partial solution

Decision points

Green preferred
Grey not favoured

Risk context, Risk assessment, Risk management



	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Growth Stage	100% leaf fall		Bud swell	Bud burst Flowering	Shuck fall Shoots		------Harvesting------		-------Post Harvest-------			50% leaf fall
Accumulated rain	*Winter and spring drought leading to dry soil profiles and low farm dams*				*Inadequate summer rain to supplement irrigation*					*Indadequate autumn rain for soil and dams*		
Rainy days						*Run of rainy days spoiling fruit*						
Hail				*Hail damage to trees*								
Wind					*Hail damage to flowers and fruit* / *Wind damage to flowers and fruit*							
Accumulated cold	*Insufficient cold units for synchronized flowering*											
Accumulated heat					*Development from full bloom to harvest shifting harvest to less ideal time*							
Night Temperaure (Min T)				*Frost damage to buds*								
Day Temperature (Max T)				*Too cold (<13) or too hot (>28)*			*Heat waves - hot days and hot nights*					

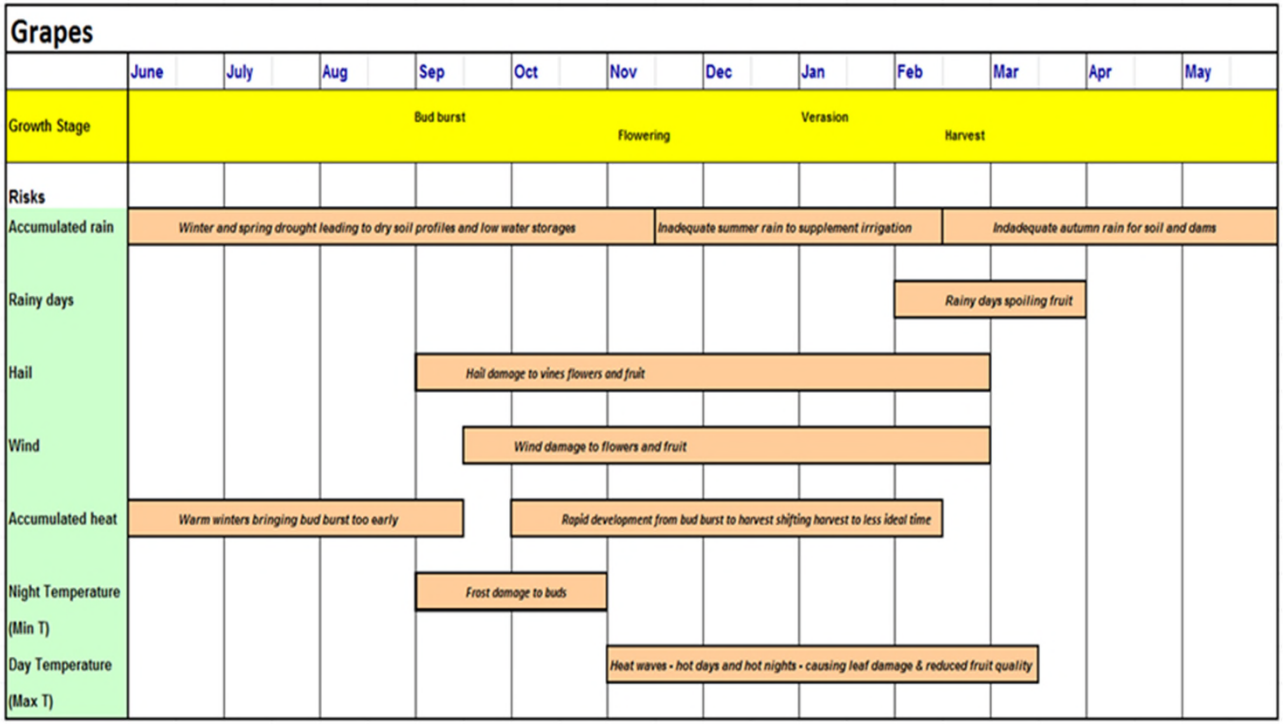
LENSWOOD	Loss	Likeihood	Score	Rank
Rainy days spoiling fruit	30%	50%	15.0	1
Heat waves	20%	50%	10.0	2
Too hot for pollination >28	15%	40%	6.0	3
Insufficient cold units	50%	70%	4.3	4
Wind damage to flowers and fruit	70%	6%	4.2	5
Heat units full bloom to harvest	20%	15%	3.0	6
Insufficent winter rain	12%	25%	3.0	8
Frost damage to buds, blosom & fruit	10%	25%	2.5	6
Hail damage to flowers and fruit	6%	35%	2.1	9
Too cold (<13) at pollination	25%	5%	1.3	10
Hail damage to trees	2%	20%	0.4	11

Young	Loss	Likeihood	Score	Rank
Wind damage to flowers and fruit	70%	30%	21.0	1
Rainy days spoiling fruit	50%	35%	17.5	2
Heat waves	35%	30%	10.5	3
Hot drying winds	20%	40%	8.0	4
Heat units full bloom to harvest	30%	23%	6.8	5
Inadequate winter season rain	40%	15%	6.0	6
Warm nights fruit Oct -Nov (>15)	35%	15%	5.3	7
Hail damage to flowers and fruit	6%	70%	4.2	8
Too cold (<13) pollination	20%	20%	4.0	9
Hail damage to trees	5%	70%	3.5	10
Insufficient cold units for sync flower	20%	3%	0.6	11
Frost damage to buds	2%	5%	0.1	13

Orange	Loss	Likeihood	Score	Rank
Rainy days spoiling fruit	40%	60%	24.0	1
Too cold (<13) pollination	40%	50%	20.0	2
Hail damage to flowers and fruit	30%	20%	6.0	3
Wind damage to flowers and fruit	80%	5%	4.0	4
Frost damage to blossom & fruit	15%	20%	3.0	5
Inadequate winter season rain	10%	20%	2.0	6
Hail damage to trees	2%	80%	1.6	7
Heat waves	10%	3%	0.3	8
Insufficient cold units for sync flower	0%	0%	0.0	9
Heat units full bloom to harvest	0%	0%	0.0	9
Too hot (>28) pollination	0%	0%	0.0	9

Yarra Valley	Loss	Likeihood	Score	Rank
Rainy days spoiling fruit	20%	40%	8.0	1
Insufficient cold units for sync flower	20%	30%	6.0	2
Wet weather on blossom	15%	20%	3.0	3
Heat units full bloom to harvest	10%	10%	1.0	4
Too cold (<13) pollination	10%	10%	1.0	4
Frost damage to buds & blossom	10%	7%	0.7	6
Hail damage to trees	1%	30%	0.3	7
Inadequate winter season rain	5%	5%	0.3	8
Hail damage to flowers and fruit	5%	5%	0.3	8
Wind damage to flowers and fruit	5%	5%	0.3	8
Hot drying winds	5%	5%	0.3	8
Too hot (>28) pollination	0%	0%	0.0	12
Heat waves	0%	0%	0.0	12

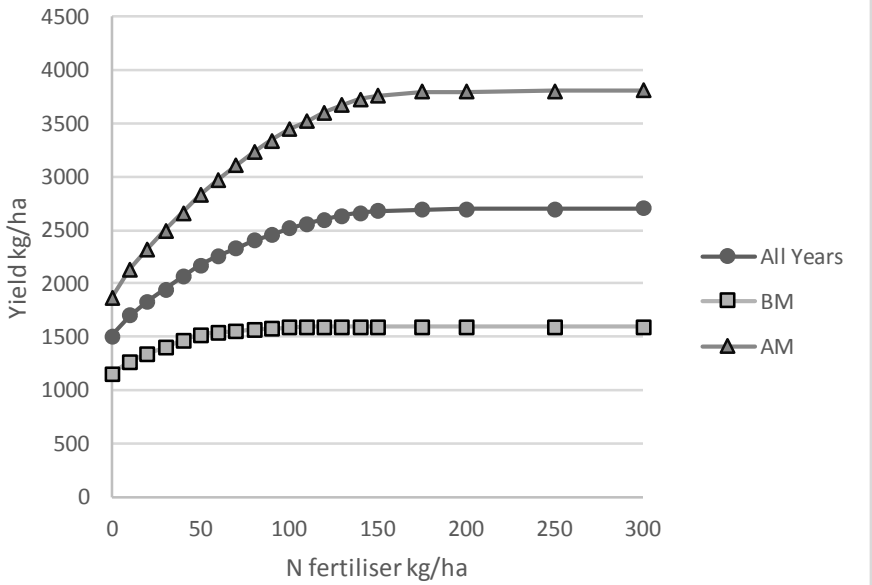
Wangaratta	Loss	Likeihood	Score	Rank
Inadequate winter season rain	80%	50%	40.0	1
Heat waves	70%	30%	21.0	2
Hot drying winds	80%	25%	20.0	3
Insufficient cold units for sync flower	65%	30%	19.5	4
Too cold (<13) pollination	50%	25%	12.5	5
Too hot (>28) pollination	50%	25%	12.5	5
Heat units full bloom to harvest	35%	20%	7.0	7
Rainy days spoiling fruit	50%	10%	5.0	8
Frost damage to buds, blossom & flr	60%	5%	3.0	9
Wind damage to flowers and fruit	7%	20%	1.4	10
Hail damage to flowers and fruit	15%	5%	0.8	11
Hail damage to trees	5%	2%	0.1	12

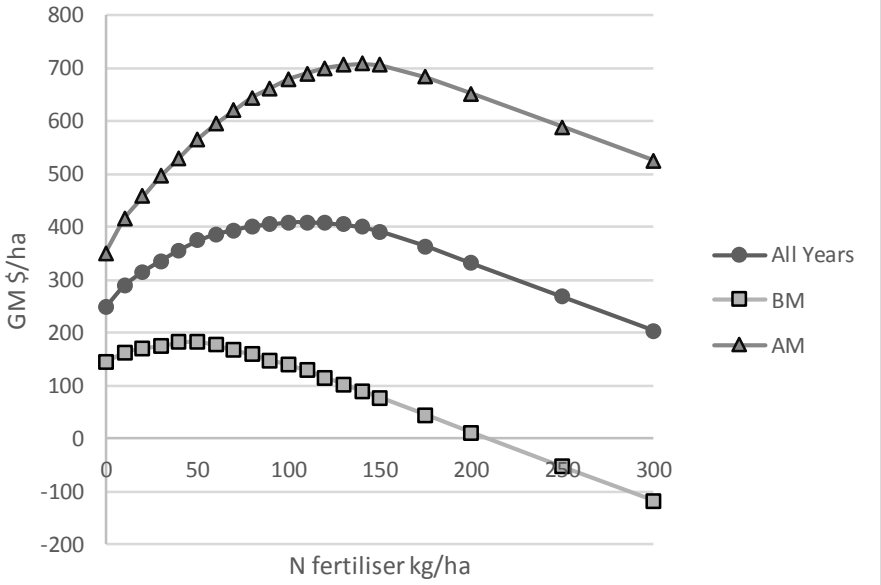

Grapes
June
July
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Growth Stage
Bud burst
Flowering
Verasion
Harvest
Risks
Accumulated rain
Winter and spring drought leading to dry soil profiles and low water storages
Inadequate summer rain to supplement irrigation
Indadequate autumn rain for soil and dams
Rainy days
Rainy days spoiling fruit
Hail
Hail damage to vines flowers and fruit
Wind
Wind damage to flowers and fruit
Accumulated heat
Warm winters bringing bud burst too early
Rapid development from bud burst to harvest shifting harvest to less ideal time
Night Temperature (Min T)
Frost damage to buds
Day Temperature (Max T)
Heat waves - hot days and hot nights - causing leaf damage & reduced fruit quality

APSIM study of POAMA for topdressing at Hart

- From 1981 to 2010 POAMA was right 19 times and wrong 11 times. (above/below median spring rain at Hart in mid north of SA).
- With assumptions of this simulation study this is worth about $8 - $20 with the higher number being due to the forecast allowing the farmer to apply more N at the same risk.

Mid north of SA – topdressing in early August
Climate file for APSIM modified so identical Jan to end of July with unique finish (Aug to Oct).
1981 to 2010 15 above median, 15 below median





PRODUCTION

kg grain/kg N

ECONOMICS

$grain/$N applied

1981 2010

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
31/10/1901	125.1	163.5	151.1	136.3	111.7	124.2	108.8	183.6	124	93.67	106.6	148.3	119.1	103.4	128.9	144.2	134.5	224.4	108.7	111.5	114.2	102.5	100.9	115.9	99.37	112.4	109.6	94.24	112.3	152.7
31/10/1902	184.8	139.6	153.6	164.2	104.8	101.1	134.3	135.4	129.4	132.3	101.1	103.4	144.3	181.9	158.9	106.7	106.7	133.9	141	111.1	105.4	98.21	112	98.98	111.3	151.9	110.6	91.38	118.2	131.6
31/10/1903	88.49	135.5	130	185.1	132.6	129.6	127.9	286.8	102.3	136.2	105.3	104.9	123	128.4	110.5	136.2	94.45	187.6	165.7	154.4	129.7	134.3	163.3	106.7	117.3	112.4	120.7	106.2	97.1	183.4
31/10/1904	114.2	100.2	230.1	119.4	117.3	136.3	120.1	124.3	156	147.7	116.2	131.2	139.8	110.1	128.9	145.3	122.2	283	122.8	101.3	110.3	106.5	108.8	100.5	120.8	135.6	155.2	97.24	106.5	144.2
31/10/1905	107.4	100.1	149.2	137.5	108.1	121.6	140.3	191.4	161	113.4	121.6	166.4	103.9	115.3	127.6	153.5	114.4	189.8	115.6	136	114.5	102.4	139.6	108.9	105.7	101.4	127.4	97.1	96.33	150.9
31/10/1906	101.2	104	169.5	123.1	133.3	151.1	132.9	171.3	113.9	112.7	120.4	108.5	133.3	116	113.3	101.7	97.65	235	139.6	105	117.9	96.84	139.7	141.7	104.3	98.01	99.31	104.9	96.15	202.4
31/10/1907	122.5	144	130	174.6	105.6	165	130.5	125.8	124.7	101.9	100.2	113.1	190.9	105.1	117.4	161.6	113.9	195.6	167.4	112.5	131.1	100	126.8	97.73	96.75	99.26	110.7	108.6	94.38	212.5
31/10/1908	120.3	114.8	196.4	108.7	137.4	132.6	117.4	167.3	156.1	132.6	103.1	131.1	112	116.8	97.61	163.3	124.5	220.9	96.53	95.98	139.6	100.5	141.8	111.3	127	140.8	105.2	96.06	120.8	171.9
31/10/1909	112.9	106	222.1	152.4	116.8	136	112.7	173.2	95.11	110.3	102	146.2	96.81	110.8	124.9	186	112.3	155	117	138.7	110.2	118.1	152.7	102.2	102.1	129.4	122.7	134.6	92.5	229.9
31/10/1910	136.7	101.2	164.5	184.5	98.67	109	198.2	160.7	109.7	121.3	99.31	145.6	163.6	97.22	102.3	171.2	94.78	185.9	99.67	92.91	118.2	120	126.4	105.1	121.9	128.1	103.8	142	94	181.9
31/10/1911	99.61	100.8	146.9	130	146.7	128.7	114.8	199.8	142.7	102.9	121.1	114.3	148.7	100.3	144.7	140.1	98.37	185.3	121.8	102.2	107.8	117.9	133.9	115.3	107.7	107.2	120	97.55	123.7	186.3
31/10/1912	111.6	143.8	128	149.6	132.7	149.4	128.9	191.7	100.5	95.95	110.6	127	147.4	110.5	126.4	124.3	104.7	187.4	119.7	106.7	108.4	116.3	100.5	150.4	94.97	97.56	105.8	151.9	104.1	149.4
31/10/1913	160.9	112.9	162.4	151	114.1	109.3	163.7	138.8	181.3	102.6	96.94	111.8	145.5	120.8	114.5	125.2	102.3	187.3	139.8	97.45	131.4	105.4	124.3	94.82	99.57	100.9	130.5	109.1	139.9	186.6
31/10/1914	130.4	95.47	104.7	202	135.3	174	137.5	212.3	118	121.7	141.7	133.8	94.23	112.9	106.3	114.2	107.2	171.8	153.7	118.8	120.5	108.6	118.7	97.83	136.2	104.1	118.3	108.6	97.28	235.2
31/10/1915	126.3	100.1	145.4	207.3	121.7	153.8	121.5	117.5	171.7	154.6	105.9	124.3	145.3	105.9	119.7	164.5	101.4	238	105.5	109.6	121.8	93.03	127.4	106.2	99.07	108.9	178.7	98.12	113.6	176.8
31/10/1916	123.7	101	120.1	152.4	137.9	143.2	218.7	214.8	159.1	112.4	107.8	146.7	141.5	104.9	112.2	137.1	89.54	170.7	128	110.4	108.3	108.1	150.8	119.7	100.6	132.3	195.9	99.59	116.5	194
31/10/1917	101.7	100.3	134.3	152.9	118.9	143.2	127	224.8	100.3	217.9	113.6	127.7	107.3	115.9	113.3	121.2	112.7	229.9	101.6	109.6	133.5	113.3	138.8	130.6	95.28	107.5	97.79	108.1	118.4	189.9
31/10/1918	107.2	135.7	158.9	125.7	95.18	201.8	134.8	162.5	142.4	113.4	133.6	122.4	166.6	108.7	112	127.2	93.5	200.2	94.64	124.1	114.3	124.3	103.4	116.3	107	111.6	93.28	106.2	127.9	212.1
31/10/1919	115.7	102.1	162.9	113.6	161.1	123.4	130.3	153.3	156.2	114.5	101.7	103.6	108.4	128.7	99.48	161.4	120.4	144	121.4	113.6	123.7	112.5	141.1	126.6	104	122.6	109.7	114.2	110.2	149.3
31/10/1920	132.1	119.2	160.2	137.6	155.8	151.4	106.4	114.4	104.1	111.6	93.97	99.4	123.1	105.6	106.4	142.2	143.8	136.5	137.2	143.4	101.5	105.8	142.8	101.5	112	147.2	110.7	121.7	128	124.4
31/10/1921	105	110.1	109.5	137.8	111.5	158.1	172.7	183.5	111.7	105	142.2	166	127.2	96.13	113.8	125.7	112.9	148	124.4	124.7	117.7	113.4	135.9	92.35	138.5	172.1	102.1	125.7	114.1	135.8
31/10/1922	103.3	103.5	116.3	144.6	136	148.2	132.1	168.1	119.8	126.2	120.2	119.9	118.4	152.1	109.9	182.6	110.5	175.9	94.05	107	124.2	111.7	134.9	110	138.5	114.1	129.2	106.3	110.1	258.8
31/10/1923	111.4	142.3	119.6	188.2	96.15	128.4	182	135.3	88.55	118.6	118.5	111.8	94.62	109.2	108.3	200.3	118	274.2	111.5	119.1	129.1	118.4	130.3	112.2	104.1	105.3	143.5	115.5	106.2	185.5
31/10/1924	114.4	108.1	156.6	160.9	107.8	107	99.11	152.3	155.9	132.6	111.3	147.9	107.1	121.8	92.29	109.1	145	150.3	192.2	104.8	105	90.09	102.3	153.7	91.86	101.8	147.6	138.6	122.7	146
31/10/1925	133.3	96.91	132.5	182.1	133.2	123.6	110.8	235.3	130.1	128.4	130.9	116.6	100.9	121.2	123.7	151.8	113.7	263.9	160.3	111.4	133.9	124.3	118.1	123.1	113.1	121.3	120.5	100.2	110.9	183.7
31/10/1926	105.3	125.2	164.4	133.5	134.9	127.3	134.3	154.7	113	146.5	96.45	120.9	135.1	126.4	97.96	117.9	102.2	187.1	125.9	116.4	129.5	97.6	134.4	110.4	95.91	95.07	109.2	98.31	100.7	127.1
31/10/1927	109.3	91.52	160.1	141.3	107.3	123.7	200.8	212.3	126	103.5	149.7	110.5	115.9	112.9	100.7	119.1	104.5	173.9	150.9	111.5	110.9	113.4	146.4	149.8	126.8	103.8	111.3	89.98	98.02	172.9
31/10/1928	120	96.78	156.2	155.2	119.6	143.6	106.2	172.7	145.1	110.1	150.5	145.3	107.5	116.1	107.4	113.2	141.7	356.7	101.7	112.1	97	129.2	168.9	114.1	104.7	146.1	101.3	113.4	124.3	246.5
31/10/1929	130.6	156.5	179.1	116.6	110.4	113.2	117.2	184.7	160.8	113.1	95.47	133.9	168.6	116.9	113.5	143.2	93.94	125.5	92.97	109.1	131	124	137.7	102.7	96.34	94.83	104	159	97.89	151.1
31/10/1930	122	126.6	136.6	171.3	138.8	144.5	106.5	144.8	162.7	109	95.85	93.67	160.9	131	87.98	125.4	97.05	304.6	102	120.5	103.3	117.5	155.2	125.6	95.15	188.8	133	106.6	96.04	181.5
31/10/1931	117.6	128.8	267.7	119	148.1	134	125.1	151.8	120	104.1	131.9	138.7	92.96	101.3	126.1	202.2	105.8	184.2	112.9	134.7	115.6	87.25	152.8	110	103.1	109.8	139.4	125.9	89.29	173.5
31/10/1932	102.2	127.1	175.9	139.7	122.3	116.6	183.1	128.1	107.4	94.48	169.6	119	129.2	102.8	100.3	115.6	95.56	205.9	93.69	164.4	130	115.5	115.2	124.5	141.6	106.1	127.8	105.8	155.4	201.7
31/10/1933	103.2	116.5	166.9	117.5	112.5	125.3	106.1	135.3	116.8	109.9	115.1	110.2	103	108.4	133.9	110.6	165.6	208.4	139.4	90.54	97.27	126	119.9	110.4	116.2	106.5	133.6	113.8	121.7	197.5
	118.2	116.7	156.4	149	123.2	135.7	135.8	169.9	130.5	119.7	116.1	125.6	127.8	115.6	114.6	140.7	112	200.6	124.2	115.8	117.8	110.7	131.7	114.8	110	118.6	122.1	111.7	110.8	179.6
	7	8	27	25	14	18	16	28	15	8	8	13	15	3	3	18	5	32	11	6	9	1	19	5	4	9	9	5	2	31
Actual	102.3	65	155.8	153.1	163.9	168.2	92.2	66.8	92.6	122.2	112.8	289	173.8	53.8	90	167.1	211.3	140.8	158.6	166.1	214.7	63.4	140.3	121.1	182.6	16.3	62	71.4	141.8	217.4
% of mean	73%	46%	111%	109%	117%	120%	66%	48%	66%	87%	80%	206%	124%	38%	64%	119%	150%	100%	113%	118%	153%	45%	100%	86%	130%	12%	44%	51%	101%	155%
Forecast	↓ 1	↓ 1	↑ 2	↑ 2	↓ 1	↑ 2	↓ 1	↑ 2	↓ 1	↓ 1	↓ 1	↓ 1	↓ 1	↓ 1	↓ 1	↑ 2	↓ 1	↑ 2	↓ 1	↓ 1	↓ 1	↓ 1	↑ 2	↓ 1	↓ 1	↓ 1	↓ 1	↓ 1	↑ 2	↓ 1	↑ 2
Actual	↓ 1	↓ 1	↑ 2	↑ 2	↑ 2	↑ 2	↑ 2	↓ 1	↓ 1	↓ 1	↓ 1	↑ 2	↑ 2	↓ 1	↓ 1	↑ 2	↑ 2	↑ 2	↑ 2	↑ 2	↓ 1	↓ 1	↓ 1	↑ 2	↓ 1	↓ 1	↓ 1	↓ 1	↑ 2	↑ 2

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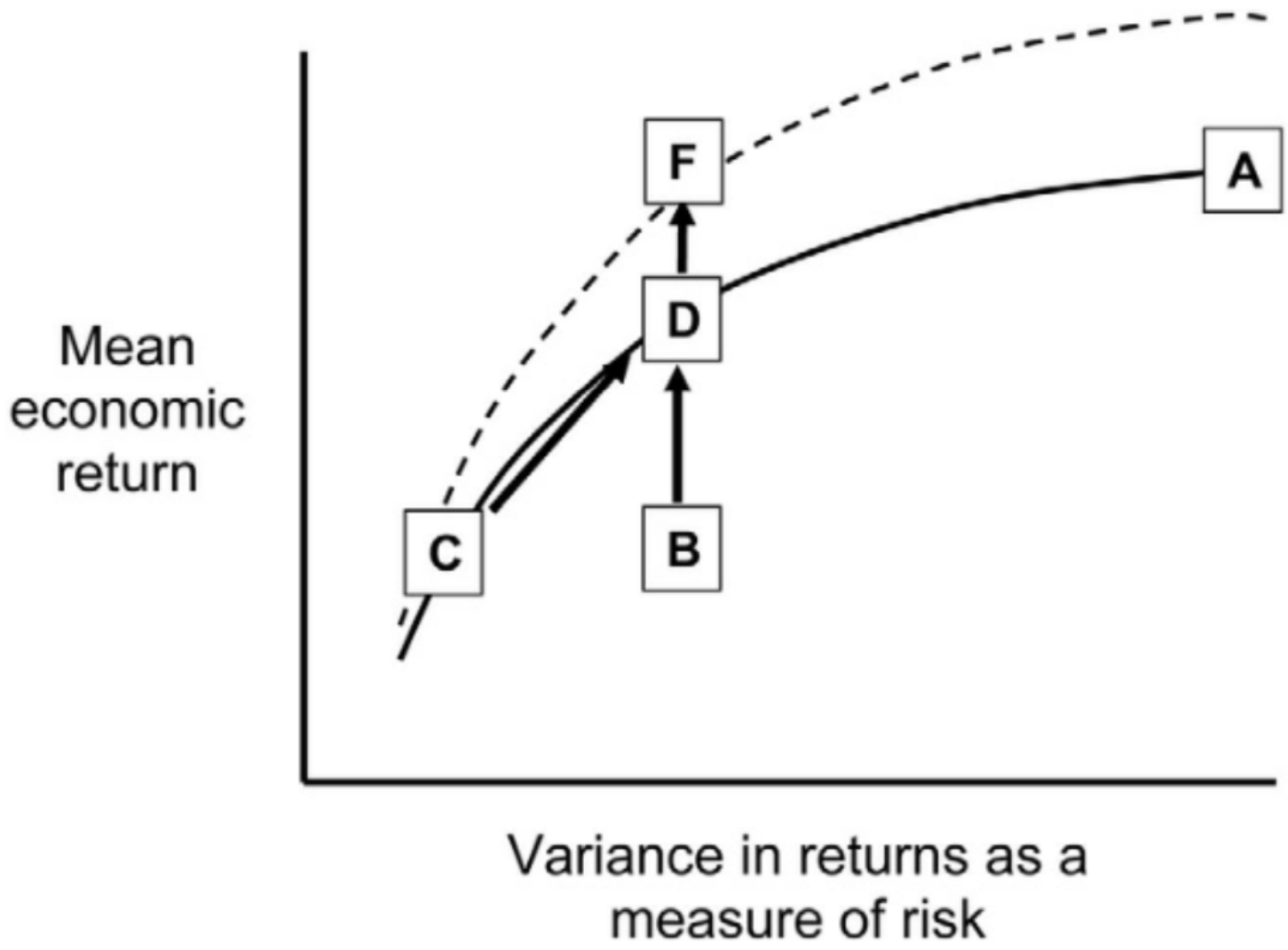
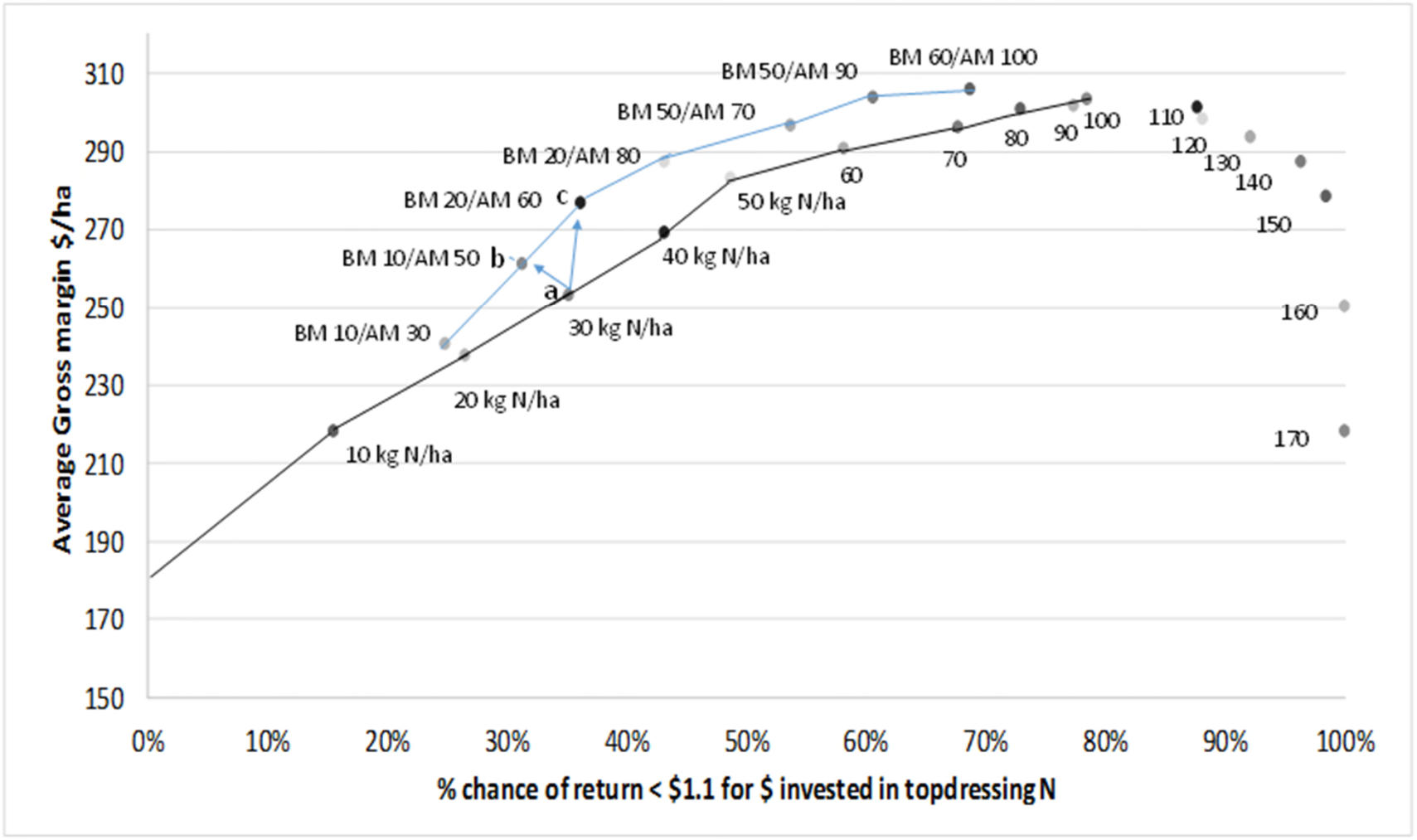

Mean economic return
F
A
D
C
B
Variance in returns as a measure of risk


Average Gross margin $/ha
310
290
270
250
230
210
190
170
150
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% chance of return < $1.1 for $ invested in topdressing N
BM 60/AM 100
BM 50/AM 90
BM 50/AM 70
BM 20/AM 80
BM 20/AM 60
BM 10/AM 50
BM 10/AM 30
c
b
a
10 kg N/ha
20 kg N/ha
30 kg N/ha
40 kg N/ha
50 kg N/ha
60
70
80
90
100
110
120
130
140
150
160
170

Main finding

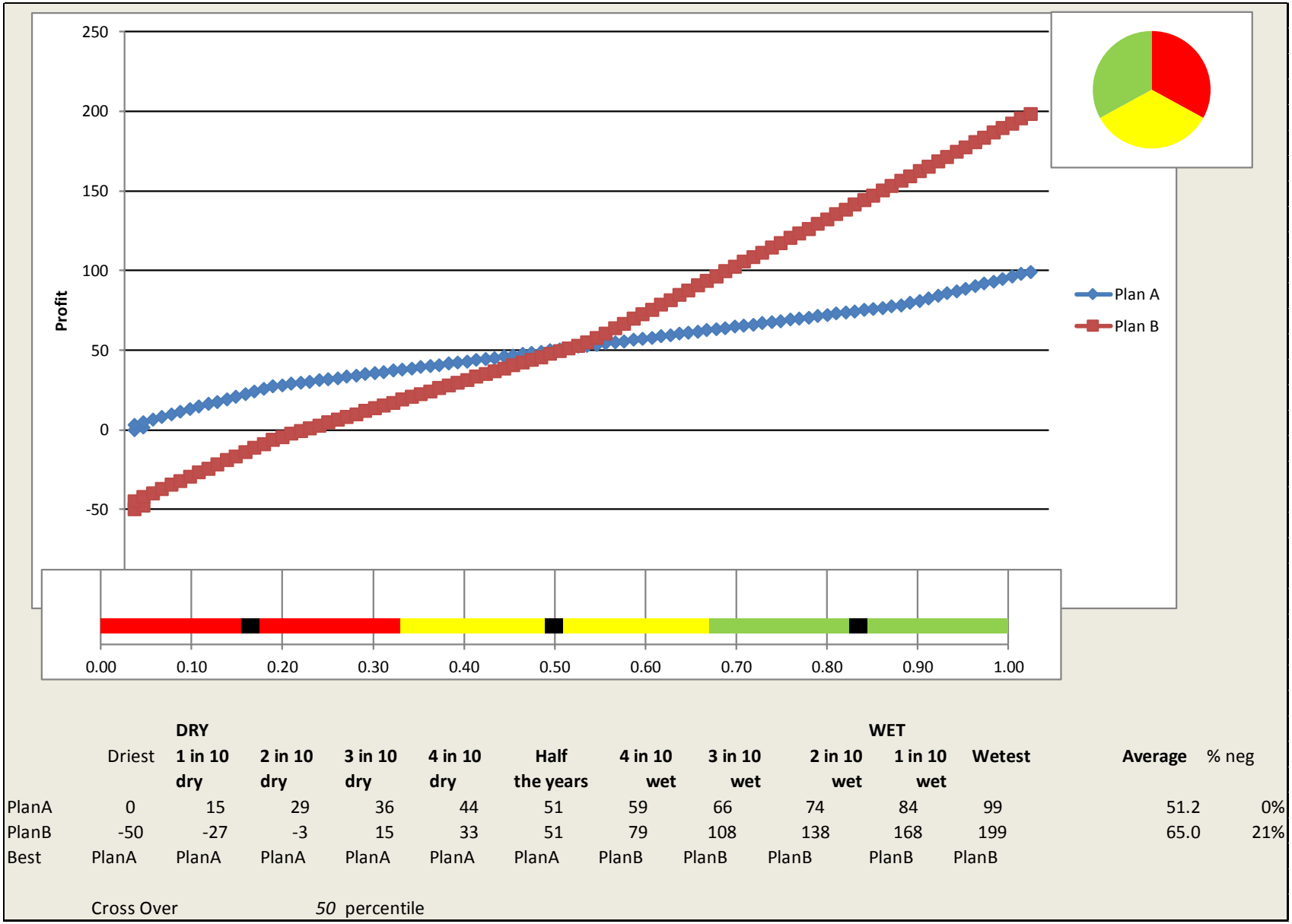
- From 1981 to 2010 POAMA was right 19 times and wrong 11 times. (above/below median spring rain at Hart).
- This simulation study suggests this is worth about $10 - $20 with the higher number being due to the forecast allowing the farmer to apply more N at the same risk.

Yes but…

- “That was a nice talk on probabilities, but in the real world people have to make decisions”

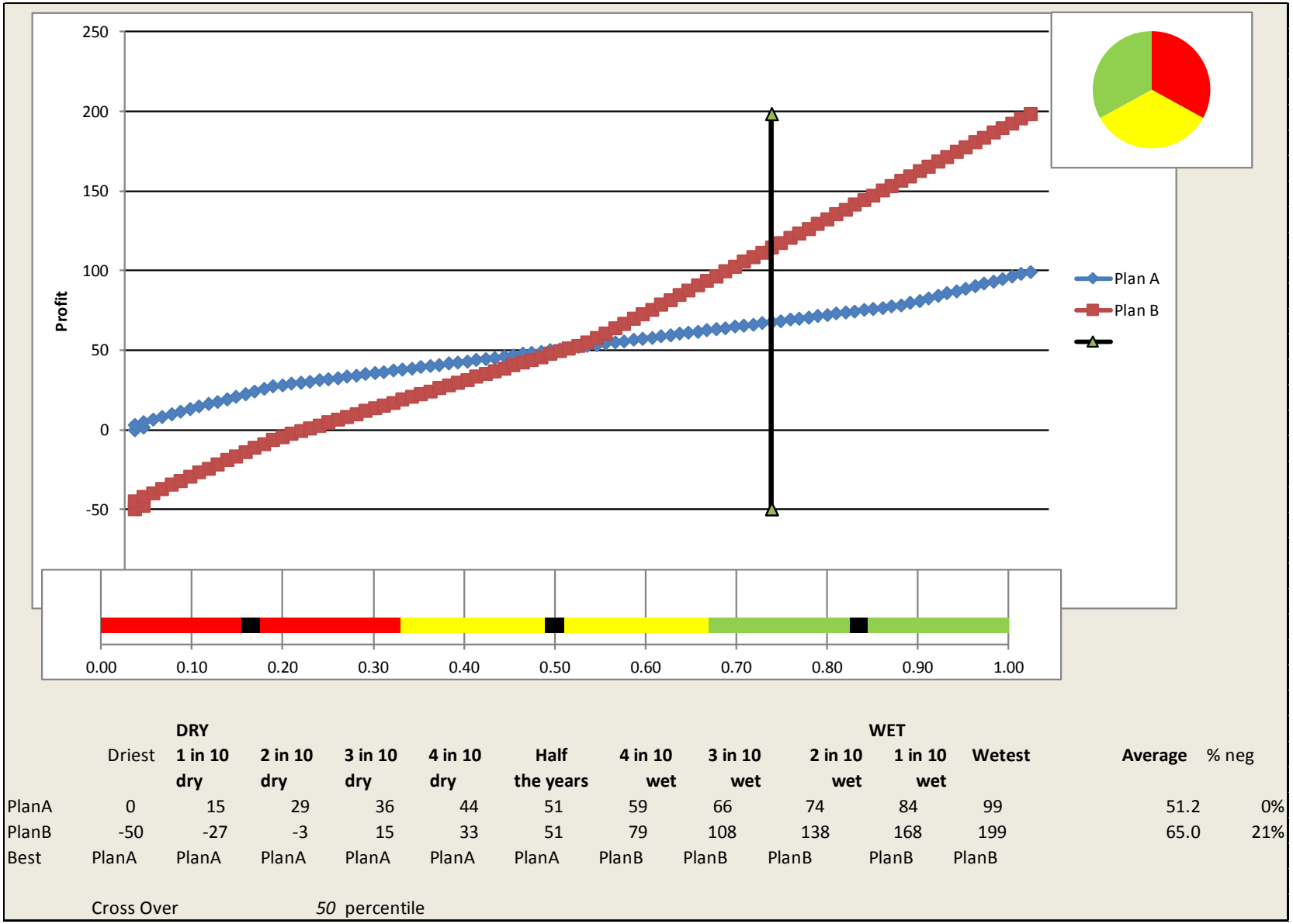
An Agronomist

	Plan A		
	Income	Cost	Profit
Driest	0	0	0
Below Normal	25	0	25
Normal	50	0	50
Above Normal	75	0	75
Wettest	100	0	100
	Plan B		
	Income	Cost	
Driest	0	50	-50
Below Normal	40	50	-10
Normal	100	50	50
Above Normal	200	50	150
Wettest	250	50	200



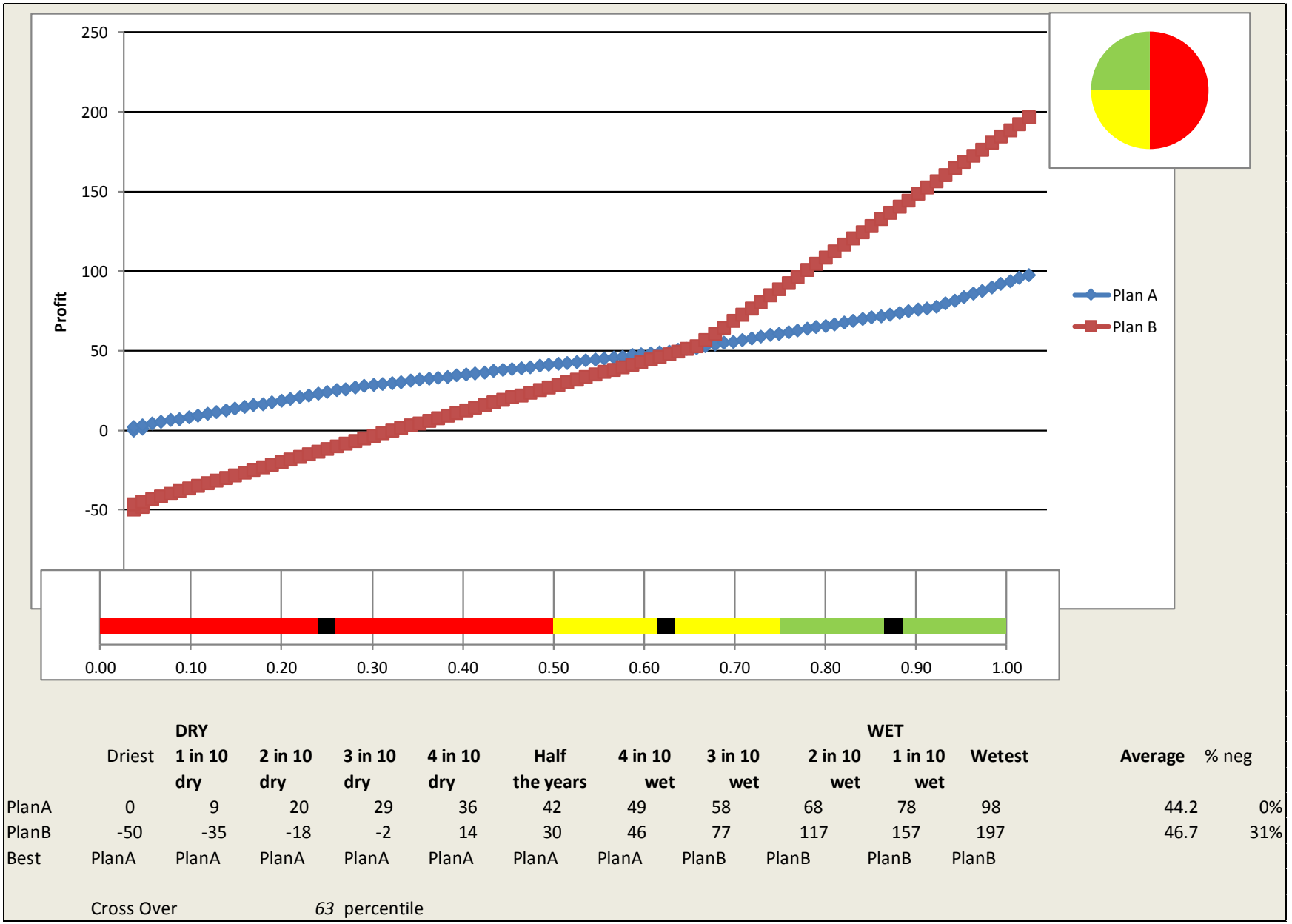
		DRY					WET						
	Driest	1 in 10 dry	2 in 10 dry	3 in 10 dry	4 in 10 dry	Half the years	4 in 10 wet	3 in 10 wet	2 in 10 wet	1 in 10 wet	Wetest	Average	% neg
PlanA	0	15	29	36	44	51	59	66	74	84	99	51.2	0%
PlanB	-50	-27	-3	15	33	51	79	108	138	168	199	65.0	21%
Best	PlanA	PlanA	PlanA	PlanA	PlanA	PlanA	PlanB	PlanB	PlanB	PlanB	PlanB		

Cross Over *50* percentile



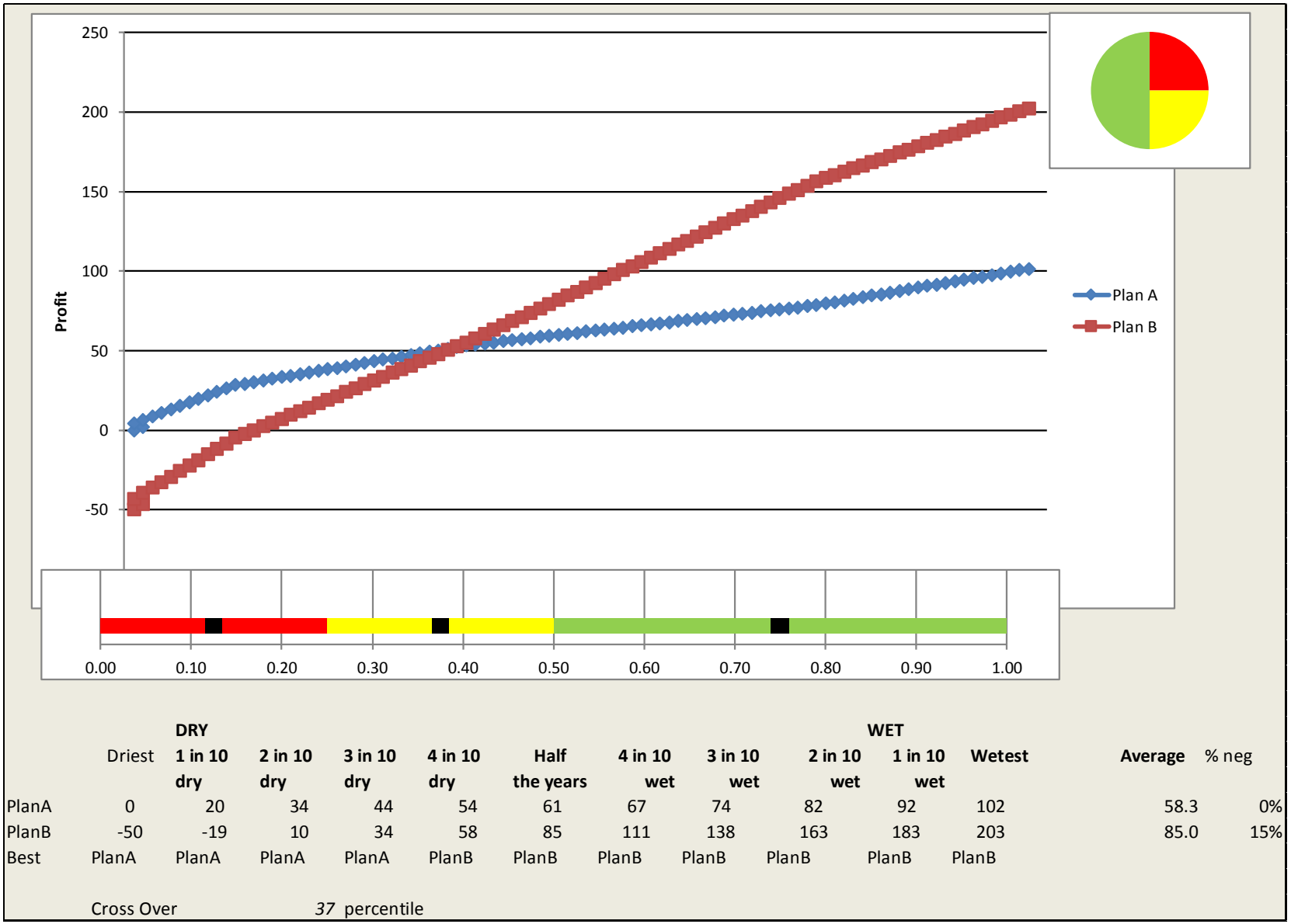
		DRY					WET						
	Driest	1 in 10 dry	2 in 10 dry	3 in 10 dry	4 in 10 dry	Half the years	4 in 10 wet	3 in 10 wet	2 in 10 wet	1 in 10 wet	Wetest	Average	% neg
PlanA	0	15	29	36	44	51	59	66	74	84	99	51.2	0%
PlanB	-50	-27	-3	15	33	51	79	108	138	168	199	65.0	21%
Best	PlanA	PlanA	PlanA	PlanA	PlanA	PlanA	PlanB	PlanB	PlanB	PlanB	PlanB		

Cross Over *50* percentile



		DRY					WET						
	Driest	1 in 10 dry	2 in 10 dry	3 in 10 dry	4 in 10 dry	Half the years	4 in 10 wet	3 in 10 wet	2 in 10 wet	1 in 10 wet	Wetest	Average	% neg
PlanA	0	9	20	29	36	42	49	58	68	78	98	44.2	0%
PlanB	-50	-35	-18	-2	14	30	46	77	117	157	197	46.7	31%
Best	PlanA	PlanA	PlanA	PlanA	PlanA	PlanA	PlanA	PlanB	PlanB	PlanB	PlanB		

Cross Over *63* percentile



		DRY					WET						
	Driest	1 in 10 dry	2 in 10 dry	3 in 10 dry	4 in 10 dry	Half the years	4 in 10 wet	3 in 10 wet	2 in 10 wet	1 in 10 wet	Wetest	Average	% neg
PlanA	0	20	34	44	54	61	67	74	82	92	102	58.3	0%
PlanB	-50	-19	10	34	58	85	111	138	163	183	203	85.0	15%
Best	PlanA	PlanA	PlanA	PlanA	PlanB	PlanB	PlanB	PlanB	PlanB	PlanB	PlanB		

Cross Over *37* percentile

Features

- Currently SCF work in about half the country, half the time (late winter and spring in SA)
- Work = above/below median hit twice as often as miss
- Too good to ignore, not good enough to rely on
- A challenge for ag scientists like me trained to use 95% confidence intervals on most agricultural technology.

If_Then_Else

- ***IF*** the season is going to be dry - ***THEN*** plant low risk crops ***ELSE*** high risk crops.
- If the end point is better risk management, misunderstanding forecasts as categorical will result in poorer risk management than if people never heard of the forecast