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Department of
Primary Industries

Straw and living mulches compared with herbicide for under-vine weed control in a Public-Private Benefit Framework

Tom Nordblom ^{1,5} Chris Penfold ²
Melanie Weckert ³ Mark Norton ^{1,4}

Wine
Australia
for
Australian
Wine

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NSW DPI = NSW Dept of Primary Industries, New South Wales, Australia

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AUSTRALIAN AGRICULTURAL &
RESOURCE ECONOMICS SOCIETY

Straw and living mulches compared with herbicide for under-vine weed control in a Public-Private Benefit Framework

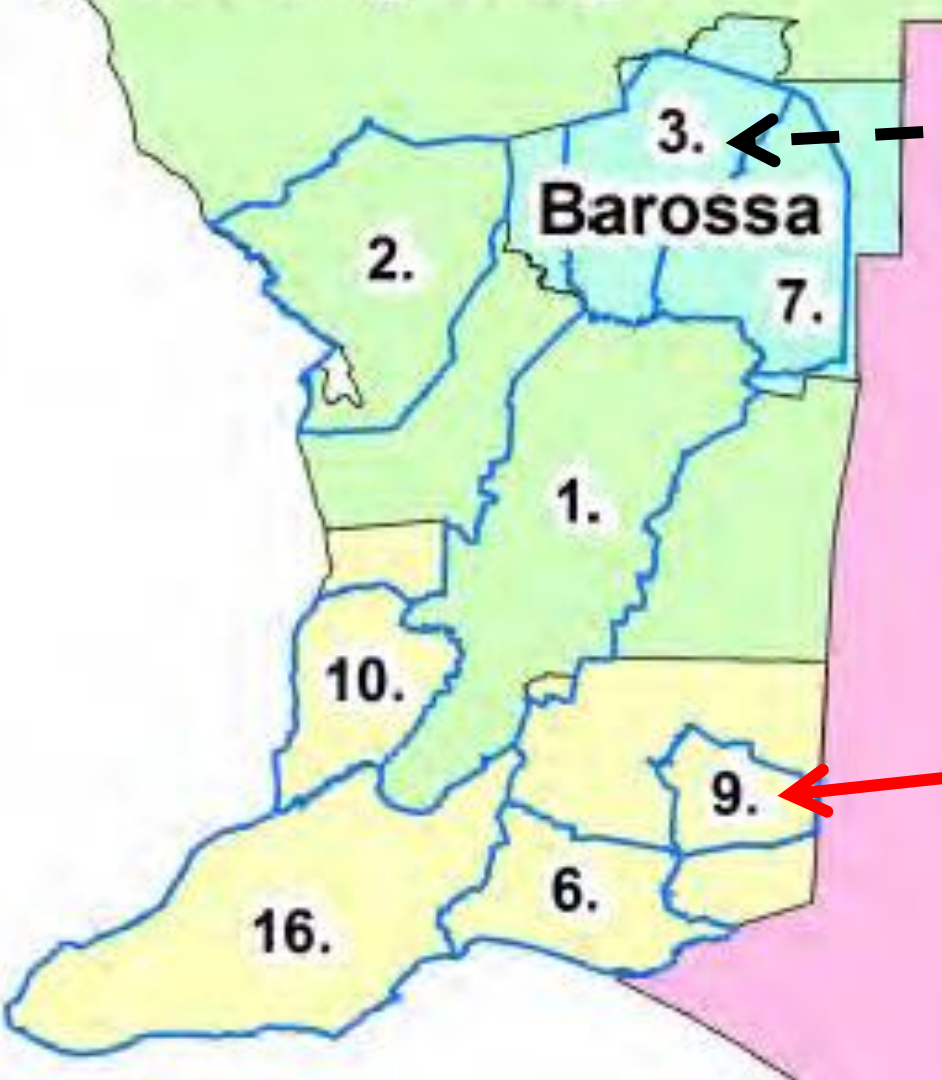
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Chris Penfold photo: *Replicated under-vine treatments, Barossa Valley, Sept 2015*





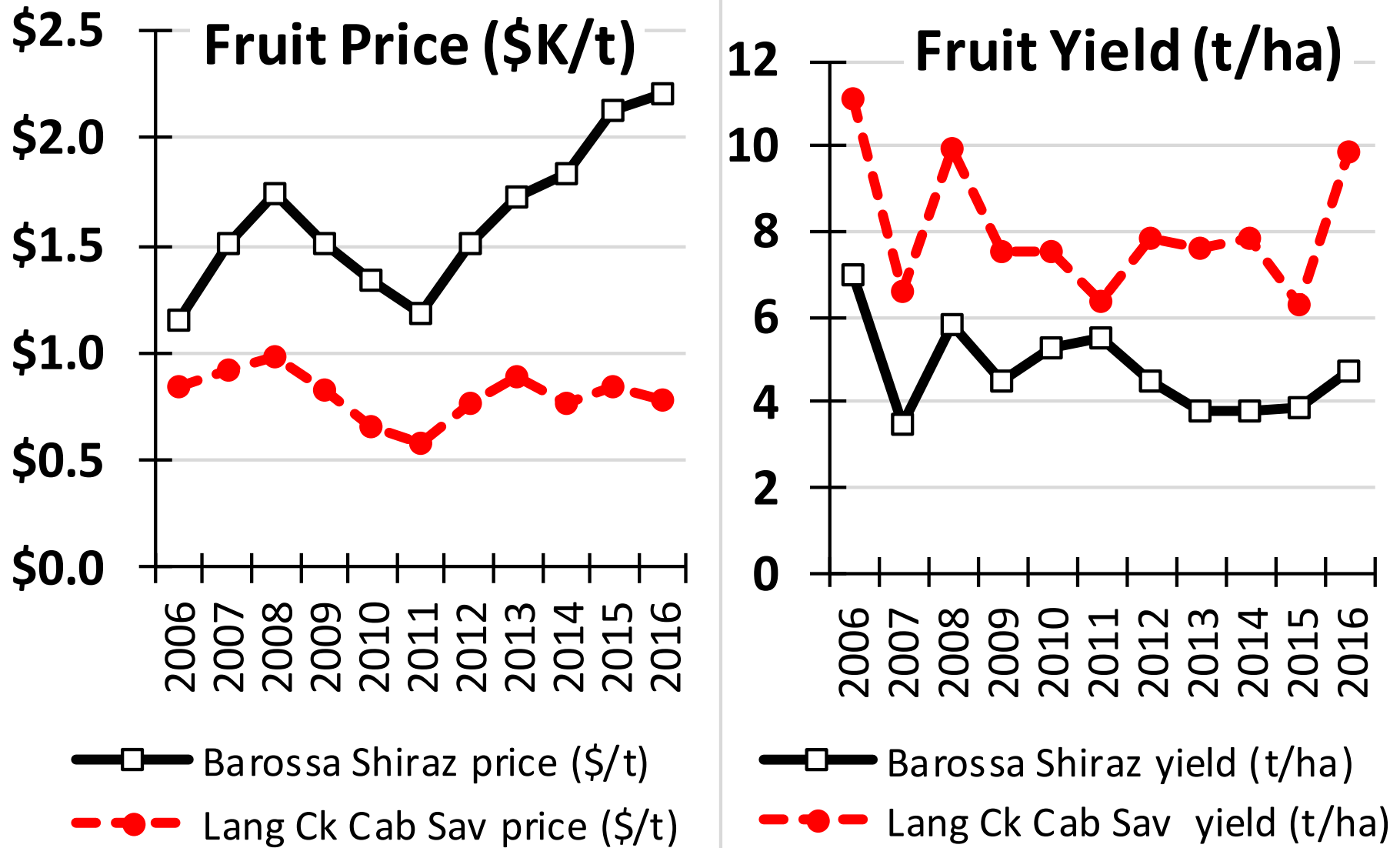
Barossa

Langhorne Creek

Chart source: Wine Australia. 2016 South Australian Winegrape Crush Survey

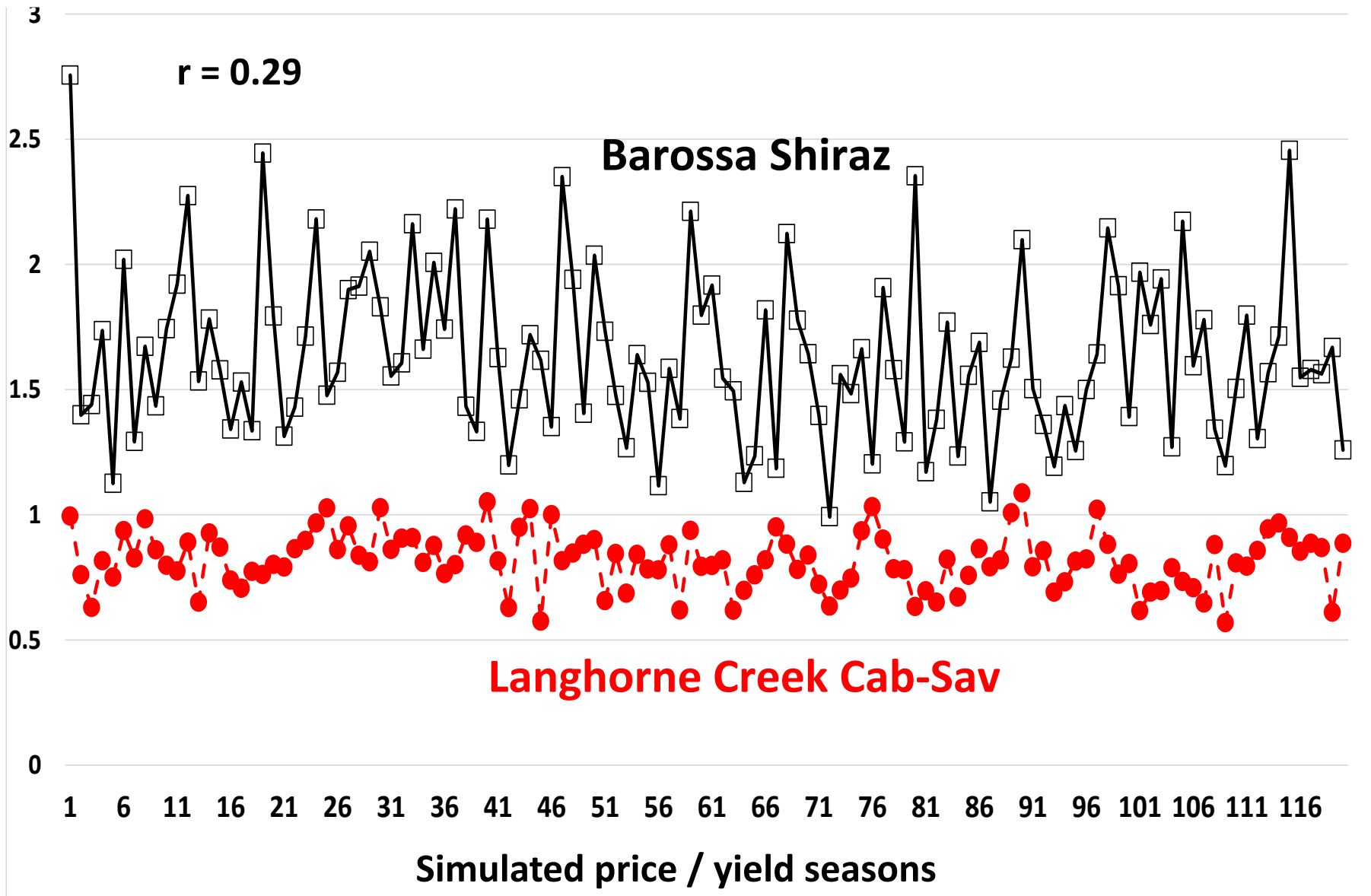
Chris Penfold photo: *Medic and Ryegrass under vines, Langhorne Creek, Nov 2016.*

Figure 1. District fruit prices and yields, 2006-16



Data source: **Wine Australia. 2016 South Australian Winegrape Crush Survey**

Fruit Prices, \$K/t

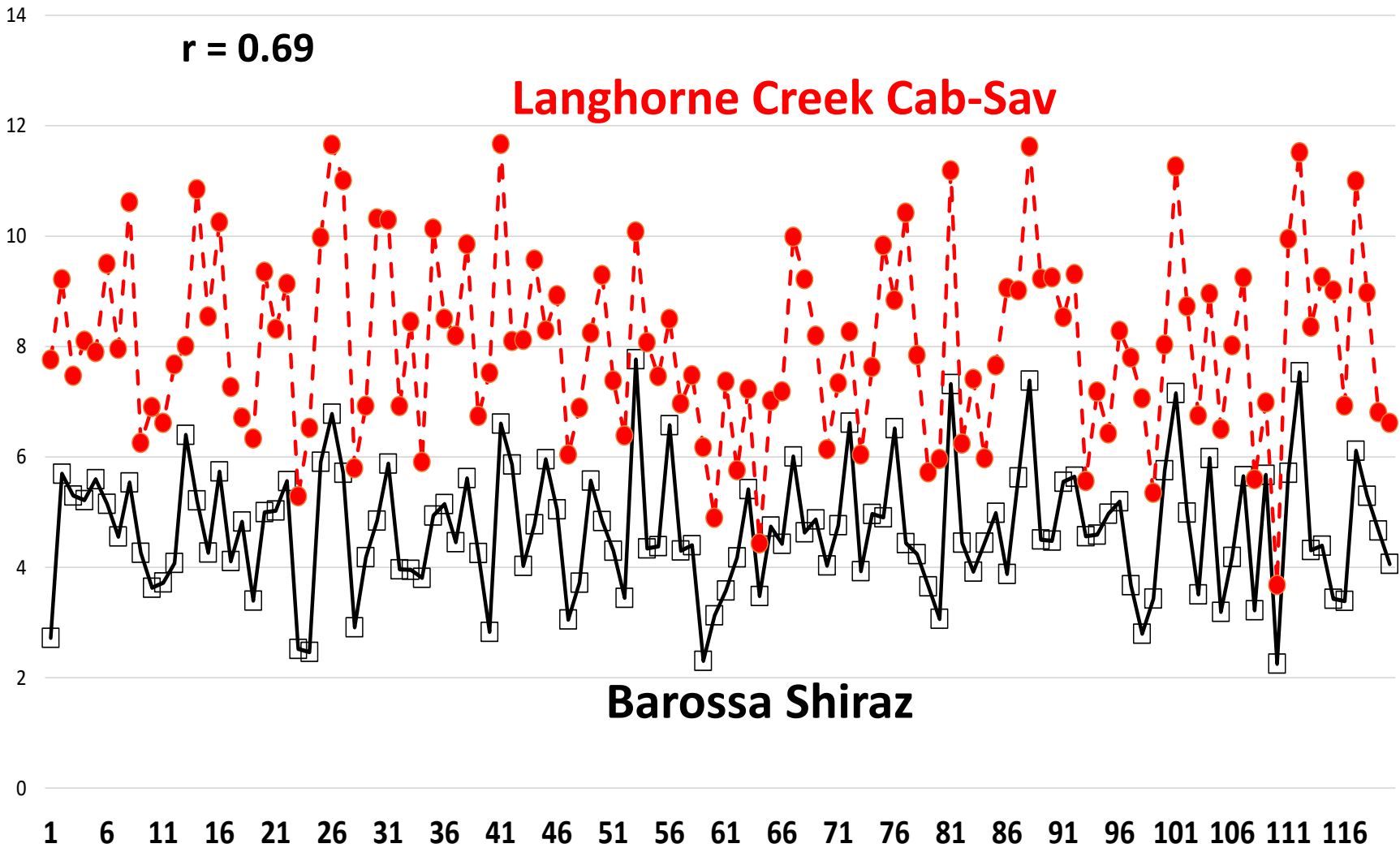


Fruit Yield, t/ha

$r = 0.69$

Langhorne Creek Cab-Sav

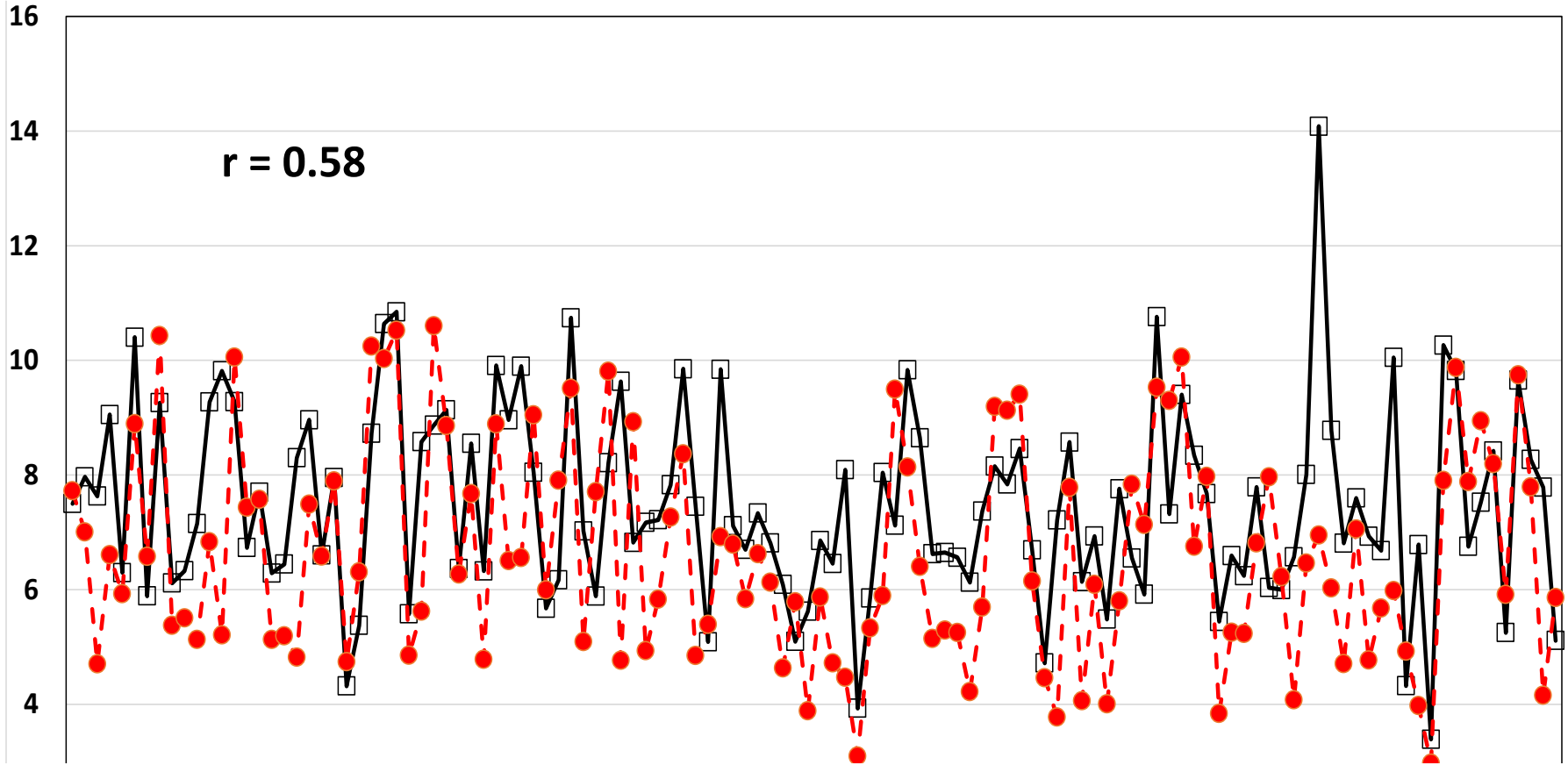
Barossa Shiraz



Simulated price / yield seasons

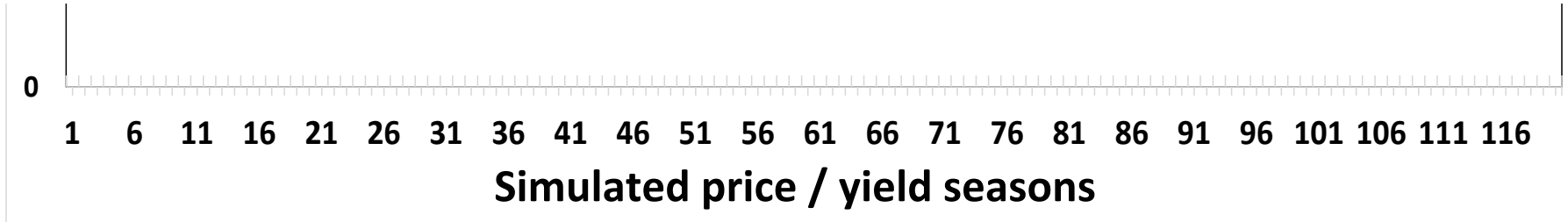
\$K/ha

Gross Revenues,



avg Barossa Shiraz (\$7,516/ha)

(\$7,397/ha) avg Lang Ck Cab-Sav



Cumulative frequency (%)

100

90

80

70

60

50

40

30

20

10

0

\$0

\$1

\$2

\$3

\$4

\$5

\$6

\$7

\$8

\$9

\$10

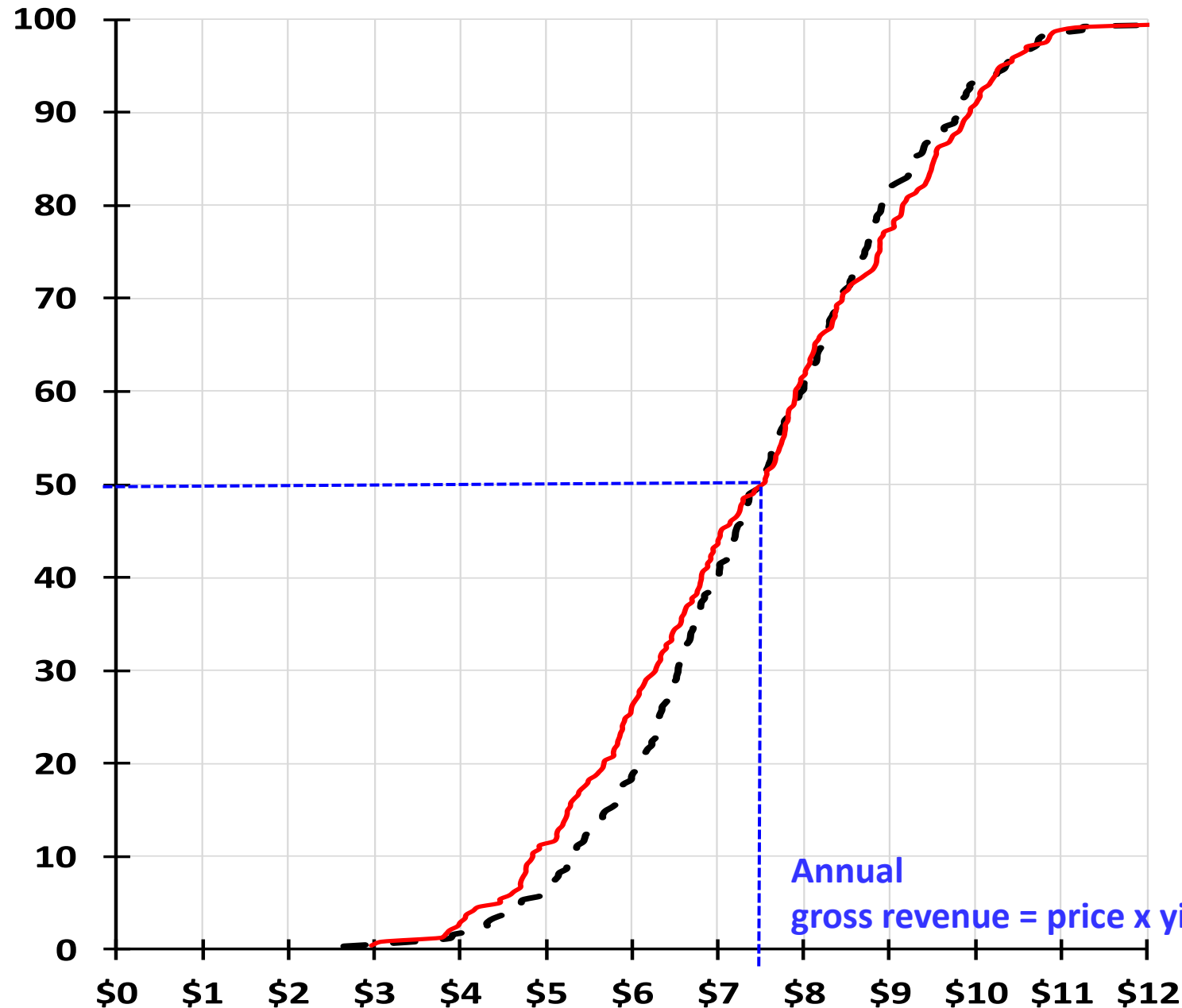
\$11

\$12

- - Barossa Shiraz \$K/ha/yr

— Lang Ck Cab Sav \$K/ha/yr

Annual
gross revenue = price x yield





GRASS

HERBICIDE

STRAW

LEGUME

Chris Penfold photo: *Replicated under-vine treatments, Barossa Valley, Sept 2015*

Table 3. Vineyard Annual Operational Costs, fixed and variable with fruit yield

COST CATEGORIES:

Annual fixed costs		Variable costs	
Barossa Shiraz fixed costs (\$/ha)	Lang Ck Cab Sav fixed costs (\$/ha)	Barossa Shiraz variable costs (\$/t/ha)	Lang Ck Cab Sav variable costs (\$/t/ha)

Under-vine weed control Options

1. Under-vine HERBICIDE sprays	75	80
Living mulches established & maintained		
2. COCKSFOOT perennial grass	150	150
3. Ryegrass & BURR MEDIC	120	120
Straw mulch purchase, apply & maintain		
4. Triticale STRAW mulch	600	600

Other fixed costs per hectare, such as:

Cultivation; Sowing, slashing inter-row areas; Pruning; Fertilizers; Insecticides; Fungicides; Repairs and maintenance; Electricity; Water; Leases; Labour (50 hrs per ha at \$25/hr); Harvesting costs, other.

Total Other Fixed costs (\$/ha)	4,591	4,936
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Variable costs depending on fruit yield (\$/t)

Harvesting	+	30	30
Freight		15	15
Levies		10	10
Extra Labour/wage (\$25/hr, 2 hrs/t)	+	50	50
Variable Costs (\$/t)		105	105






10 to 20m plots are harvested mechanically into the weigh-bin trailer - a quick and accurate operation!

Chris Penfold photo

2016 yield indices of alternative mulches relative to the HERBICIDE treatment at two locations

TREATMENT:	no mulch	---sown living mulches ---		applied mulch
	HERBICIDE control	Perennial COCKSFOOT GRASS	Ryegrass with BURR MEDIC	Triticale STRAW mulch
FIELD TRIAL LOCATION				
Barossa yield index	1	0.881	1.033	1.104
Plot yield (t/ha)	8.82	7.77	9.11	9.74
Langhorne Ck yield index	1	0.754	1.083	1.092
Plot yield (t/ha)	19.95	15.05	21.61	21.79



Gross revenues vary year to year with yields and prices;
Operational costs also vary with yields

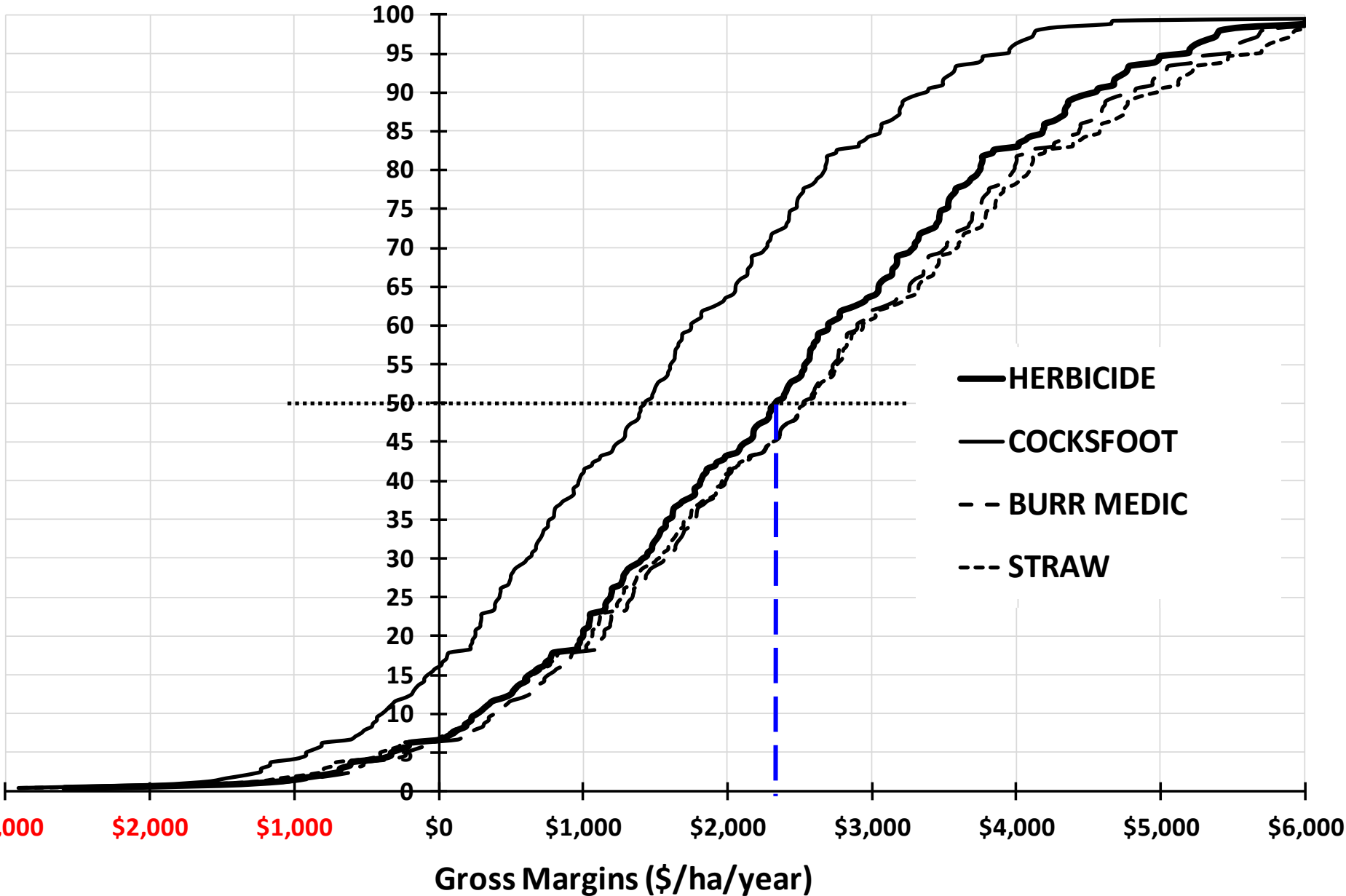
Gross Margin = Gross revenue – Operational costs

We assume yields under the different treatments differ every year while keeping their same yield ratios relative to the herbicide treatment as in their 2016 yield indices

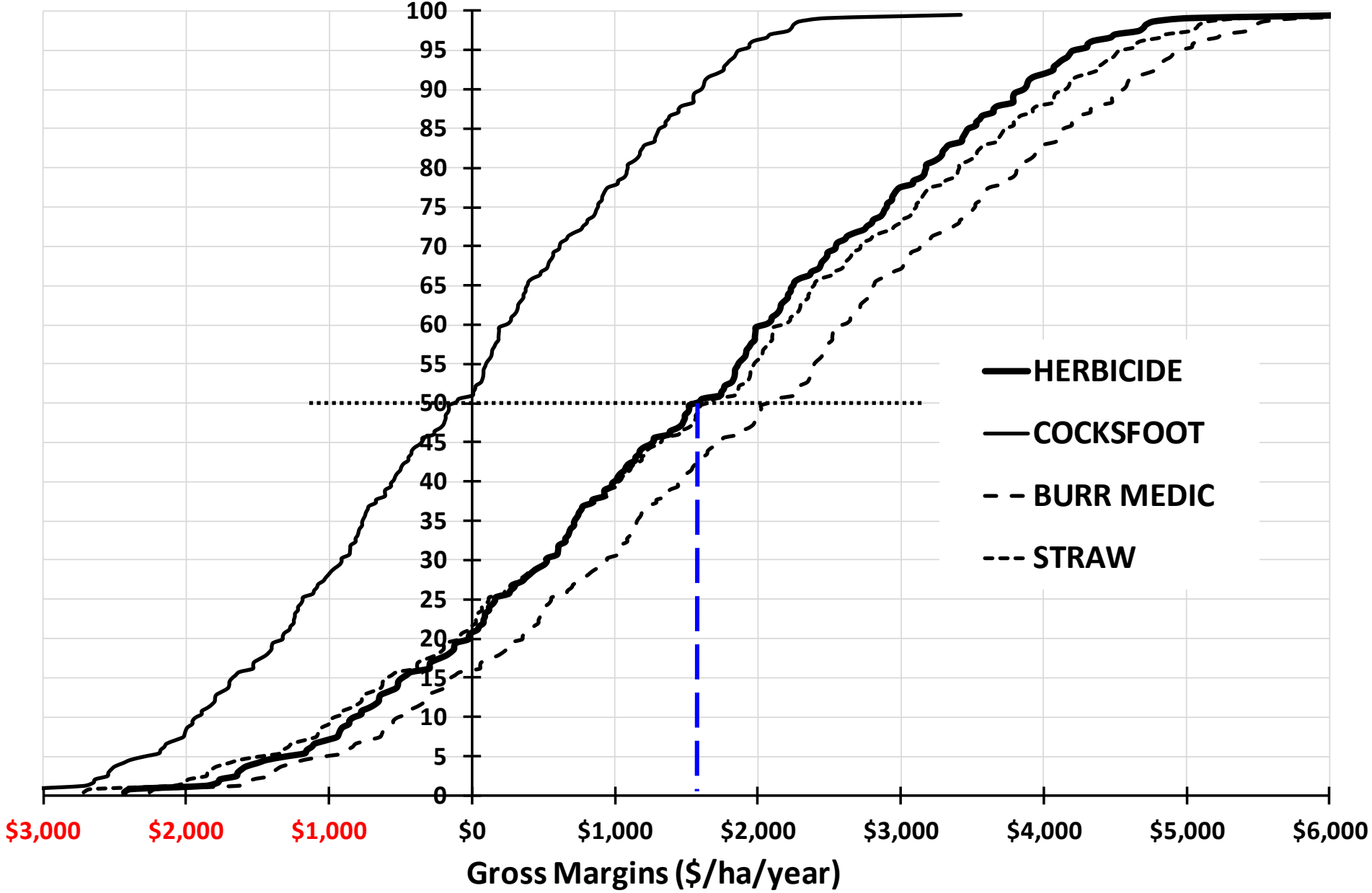
Chris Penfold photo: Strawberry clover and sheep fescue, Langhorne Creek, Nov 2016

Cumulative Distribution (%)

Barossa Gross Margins



Cumulative Distribution (%) Langhorne Creek Gross Margins

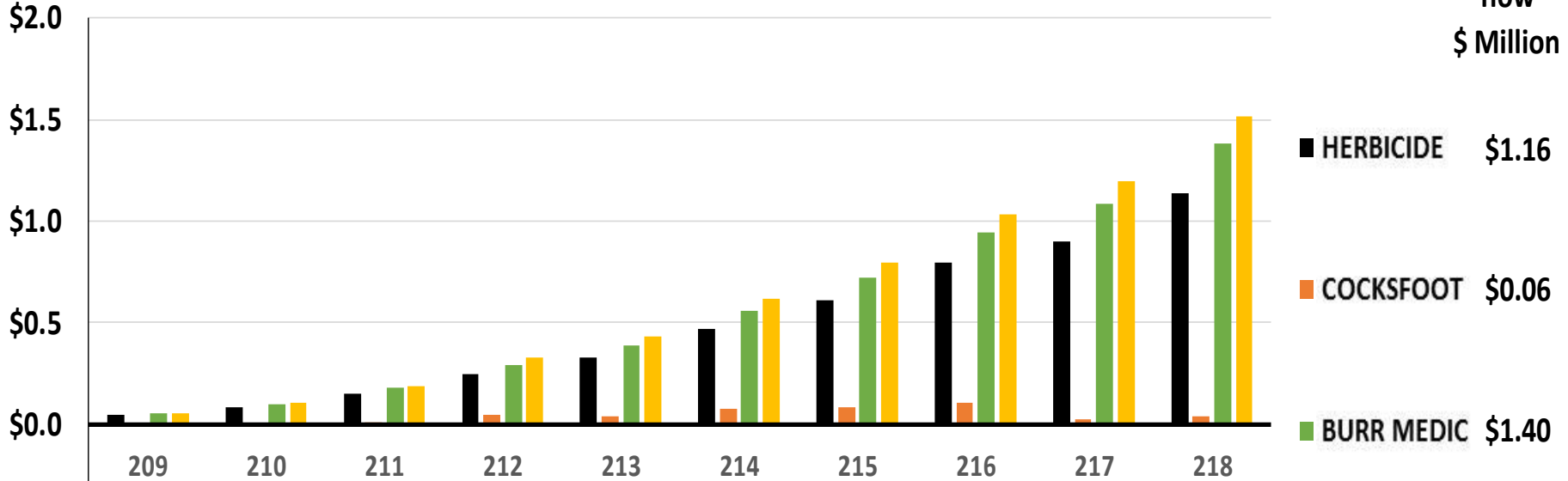


Subtracting annual overheads, drawings, interest and taxes from Gross Margins over 10-year (decadal) periods of simulated price & yield variations = Decadal cash flow

\$ Million

Decade 209

Decadal cash flow \$ Million



- HERBICIDE \$1.16
- COCKSFOOT \$0.06
- BURR MEDIC \$1.40
- STRAW \$1.54

\$0.5
\$1.0
\$1.5
\$2.0

Simulated price / yield seasons →

Barossa \$80K overhead

50 hectare vineyard

\$ Million

Decade 110

Decadal
cash
flow
\$ Million

\$2.0

\$1.5

\$1.0

\$0.5

\$0.0

\$0.5

\$1.0

\$1.5

\$2.0

■ HERBICIDE \$0.50

■ COCKSFOOT \$0.19

■ BURR MEDIC \$0.76

■ STRAW \$0.79

110

111

112

113

114

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116

117

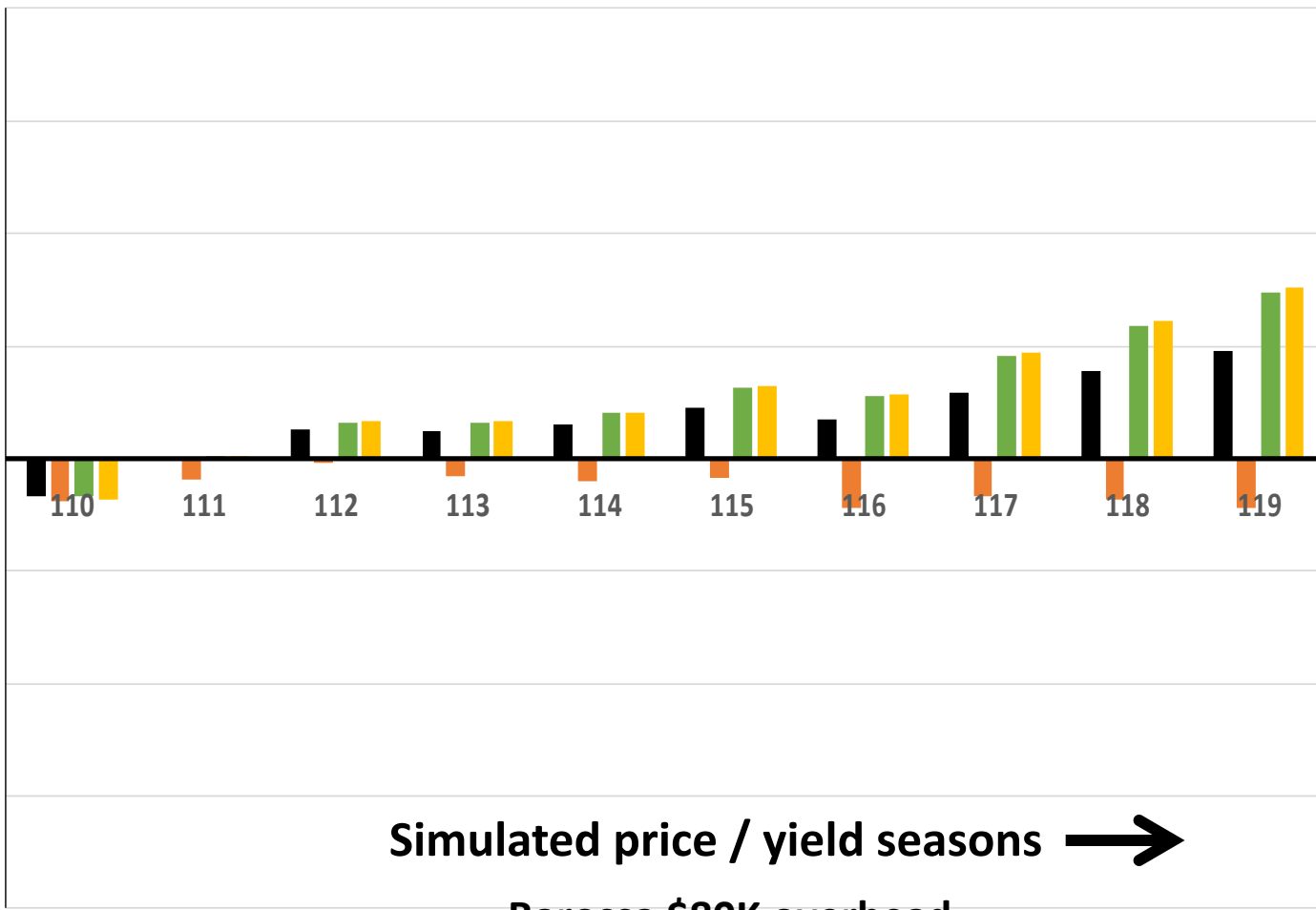
118

119

Simulated price / yield seasons →

Barossa \$80K overhead

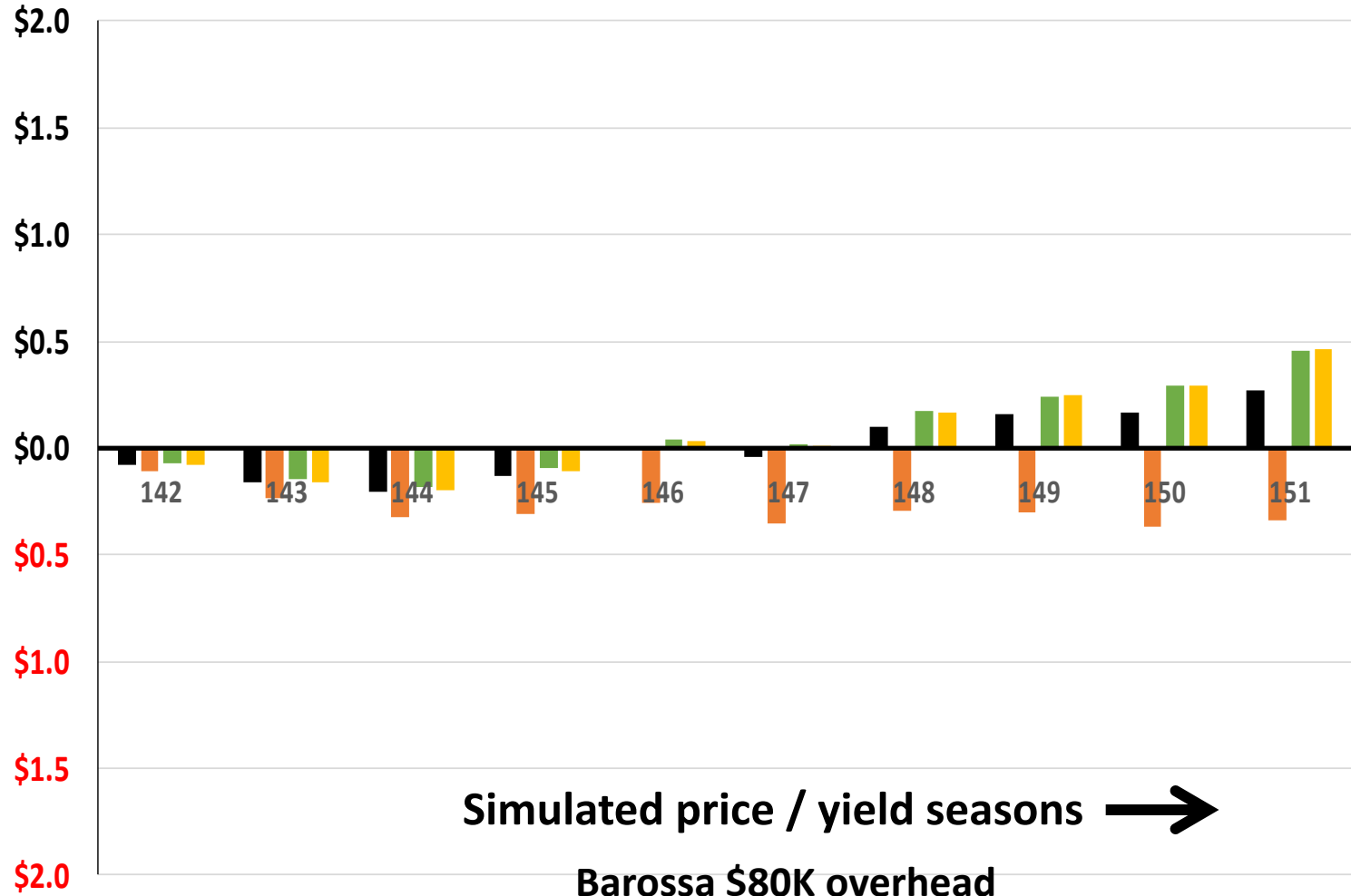
50 hectare vineyard



\$ Million

Decade 142

Decadal
cash
flow
\$ Million



- HERBICIDE \$0.30
- COCKSFOOT \$0.31
- BURR MEDIC \$0.48
- STRAW \$0.49

Simulated price / yield seasons →

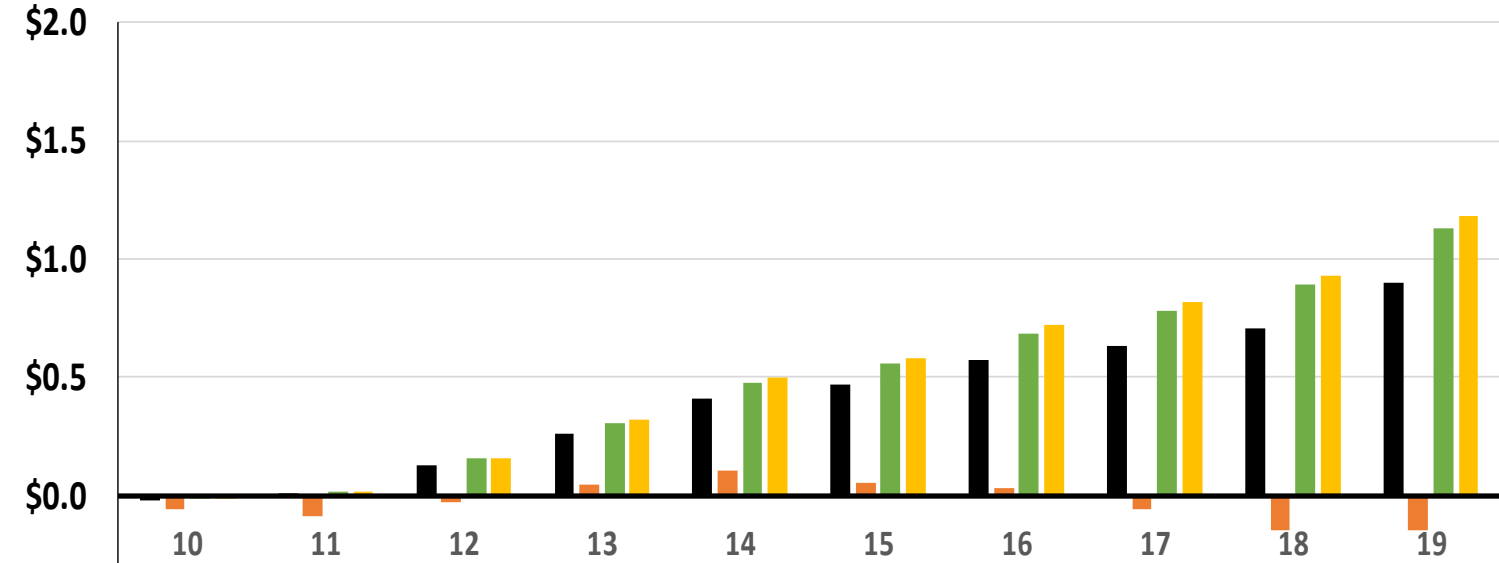
Barossa \$80K overhead

50 hectare vineyard

Decadal
cash
flow
\$ Million

\$ Million

Decade 10



- HERBICIDE \$0.92
- COCKSFOOT \$0.12
- BURR MEDIC \$1.16
- STRAW \$1.21

Simulated price / yield seasons →

Barossa \$80K overhead

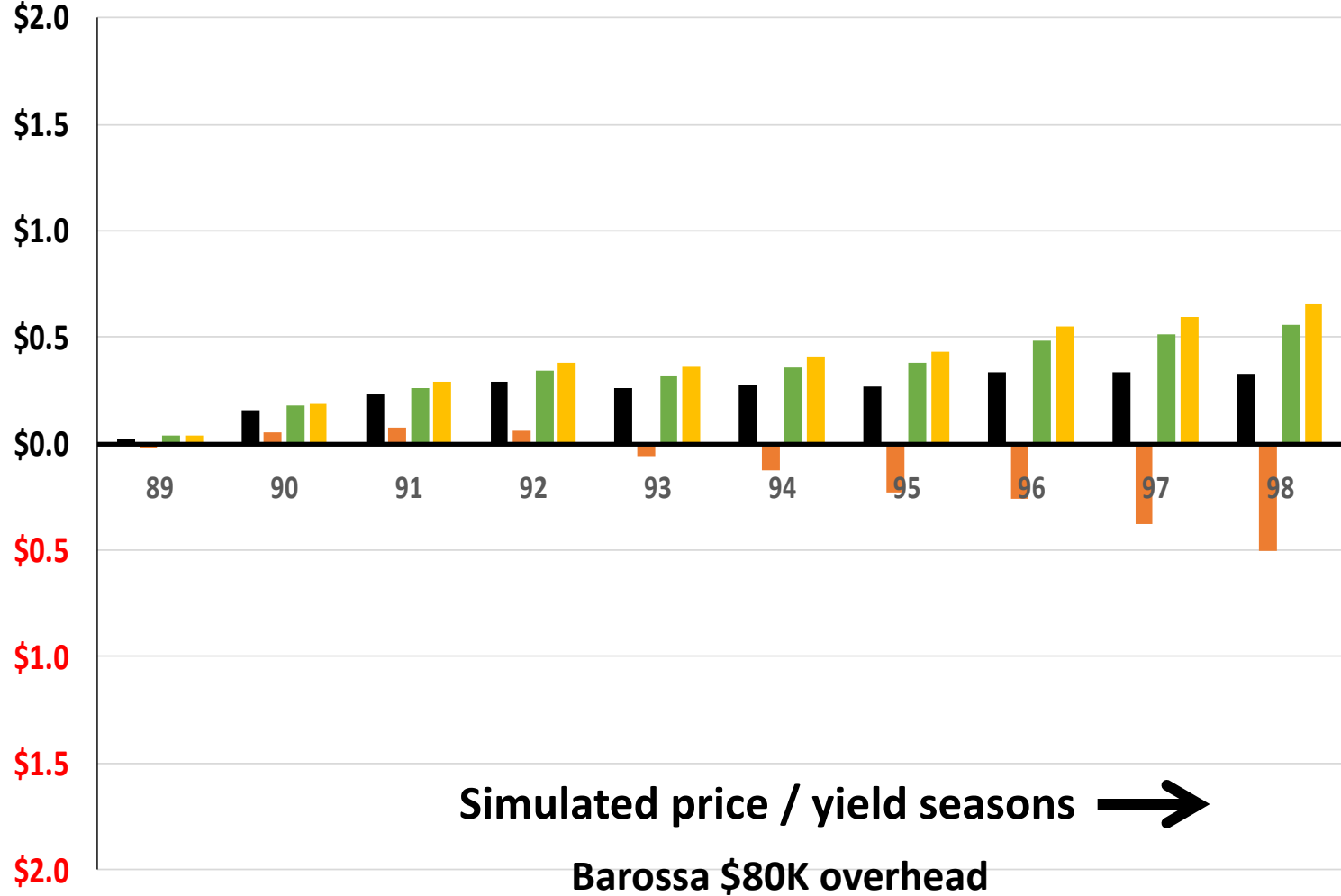
50 hectare vineyard

\$0.5
\$1.0
\$1.5
\$2.0

\$ Million

Decade 89

Decadal
cash
flow
\$ Million



- HERBICIDE \$0.36
- COCKSFOOT \$0.48
- BURR MEDIC \$0.58
- STRAW \$0.68

Simulated price / yield seasons →

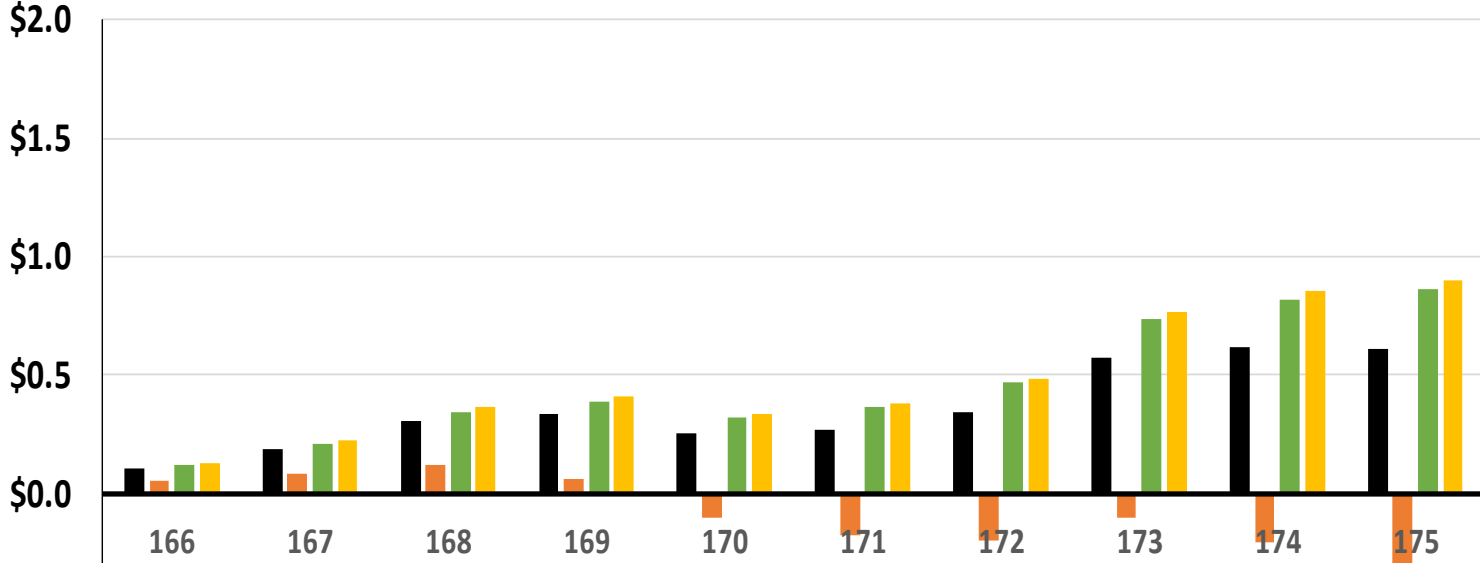
Barossa \$80K overhead

50 hectare vineyard

Decadal
cash
flow
\$ Million

\$ Million

Decade 166



- HERBICIDE \$0.63
- COCKSFOOT \$0.35
- BURR MEDIC \$0.89
- STRAW \$0.92

Simulated price / yield seasons →

Barossa \$80K overhead

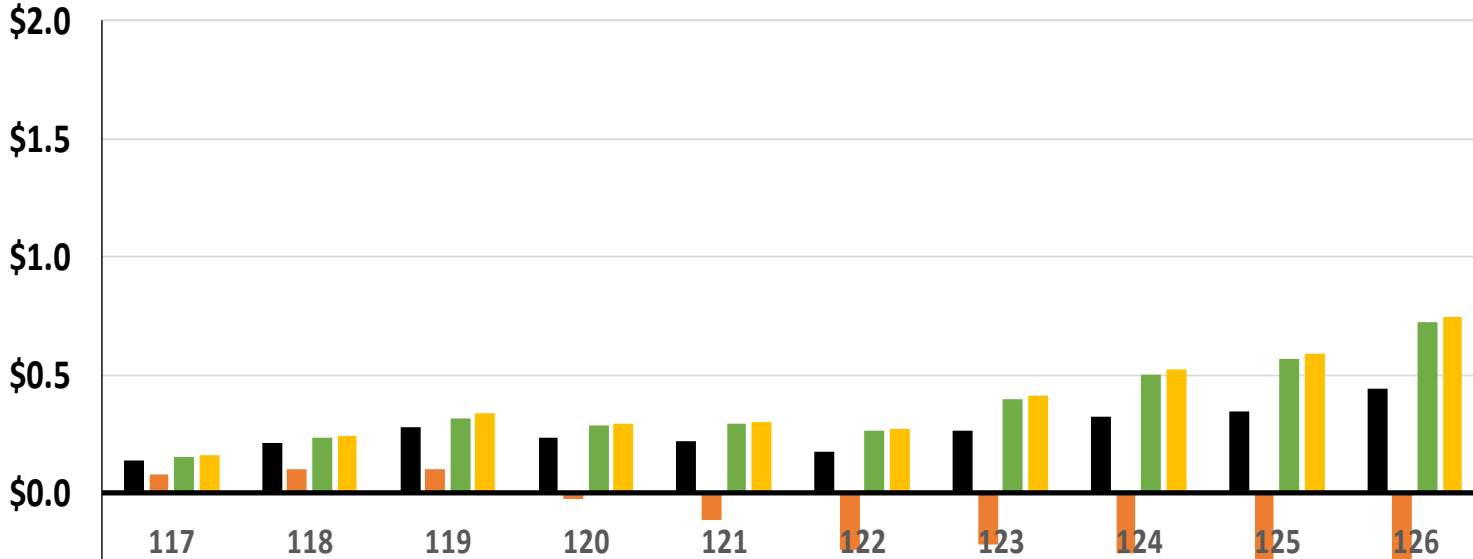
50 hectare vineyard

\$0.5
\$1.0
\$1.5
\$2.0

\$ Million

Decade 117

Decadal
cash
flow
\$ Million



- HERBICIDE \$0.47
- COCKSFOOT \$0.36
- BURR MEDIC \$0.75
- STRAW \$0.77

\$0.5
\$1.0
\$1.5
\$2.0

Simulated price / yield seasons →

Barossa \$80K overhead

50 hectare vineyard

\$ Million

Decade 230

**Decadal
cash
flow
\$ Million**

\$2.0

\$1.5

\$1.0

\$0.5

\$0.0

\$0.5

\$1.0

\$1.5

\$2.0

- HERBICIDE \$1.17
- COCKSFOOT \$0.10
- BURR MEDIC \$1.41
- STRAW \$1.54

230

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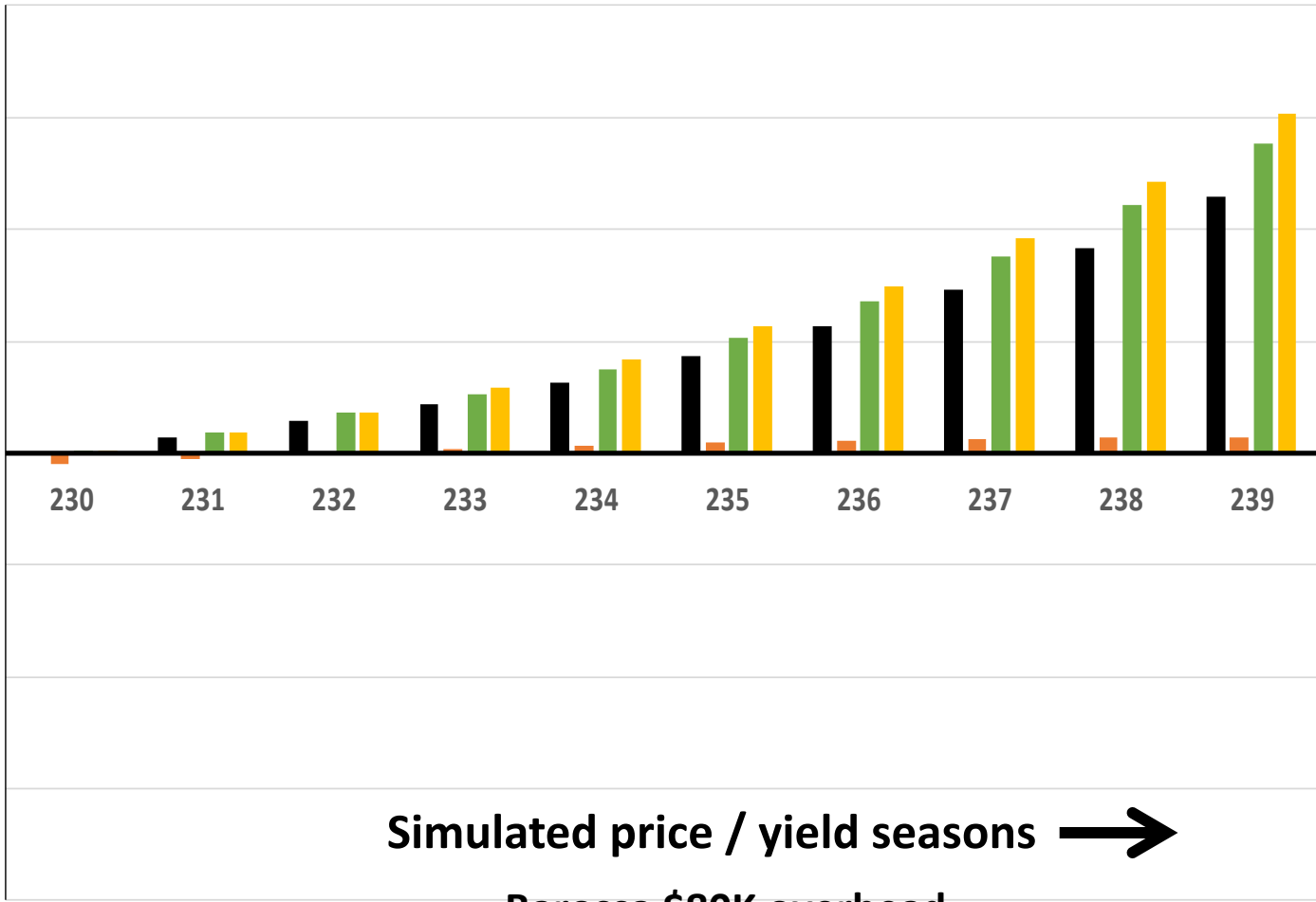
238

239

Simulated price / yield seasons →

Barossa \$80K overhead

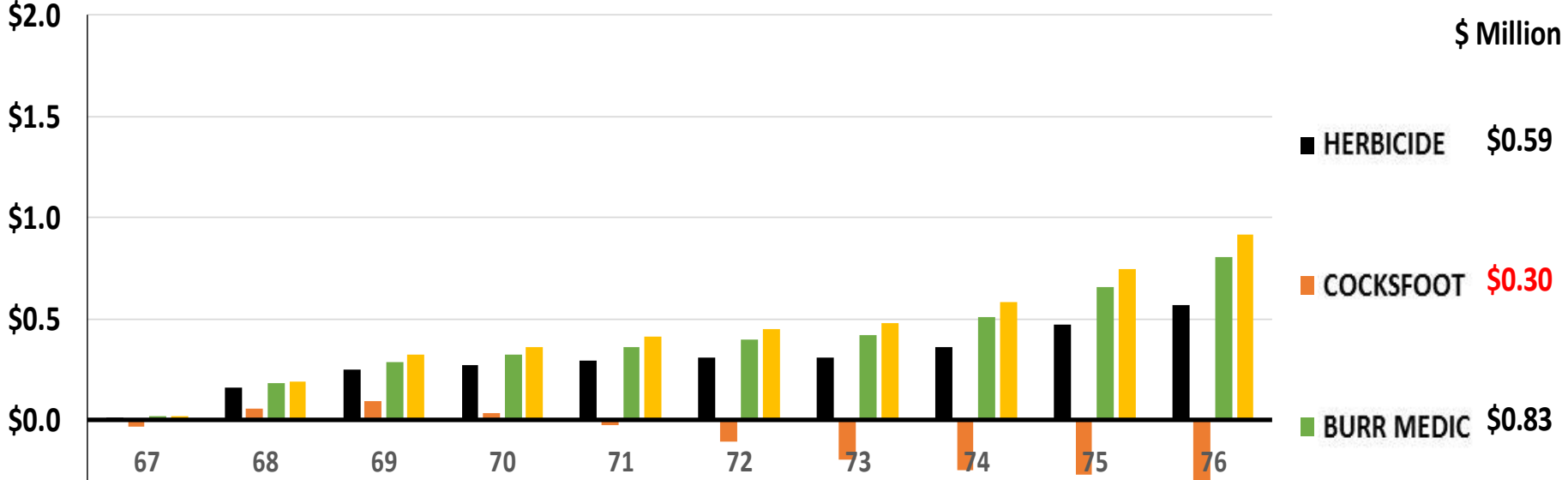
50 hectare vineyard



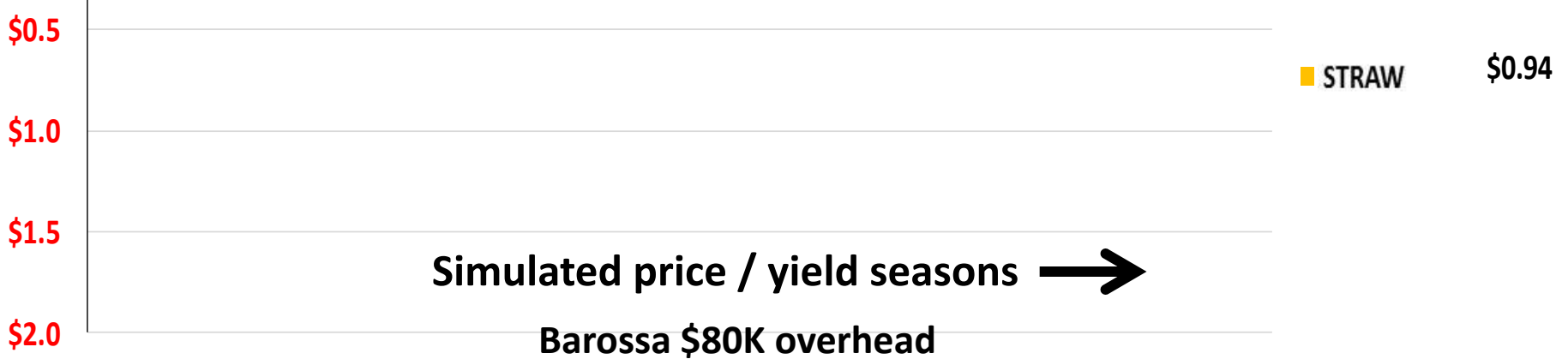
\$ Million

Decade 67

**Decadal
cash
flow
\$ Million**



- HERBICIDE \$0.59
- COCKSFOOT \$0.30
- BURR MEDIC \$0.83
- STRAW \$0.94

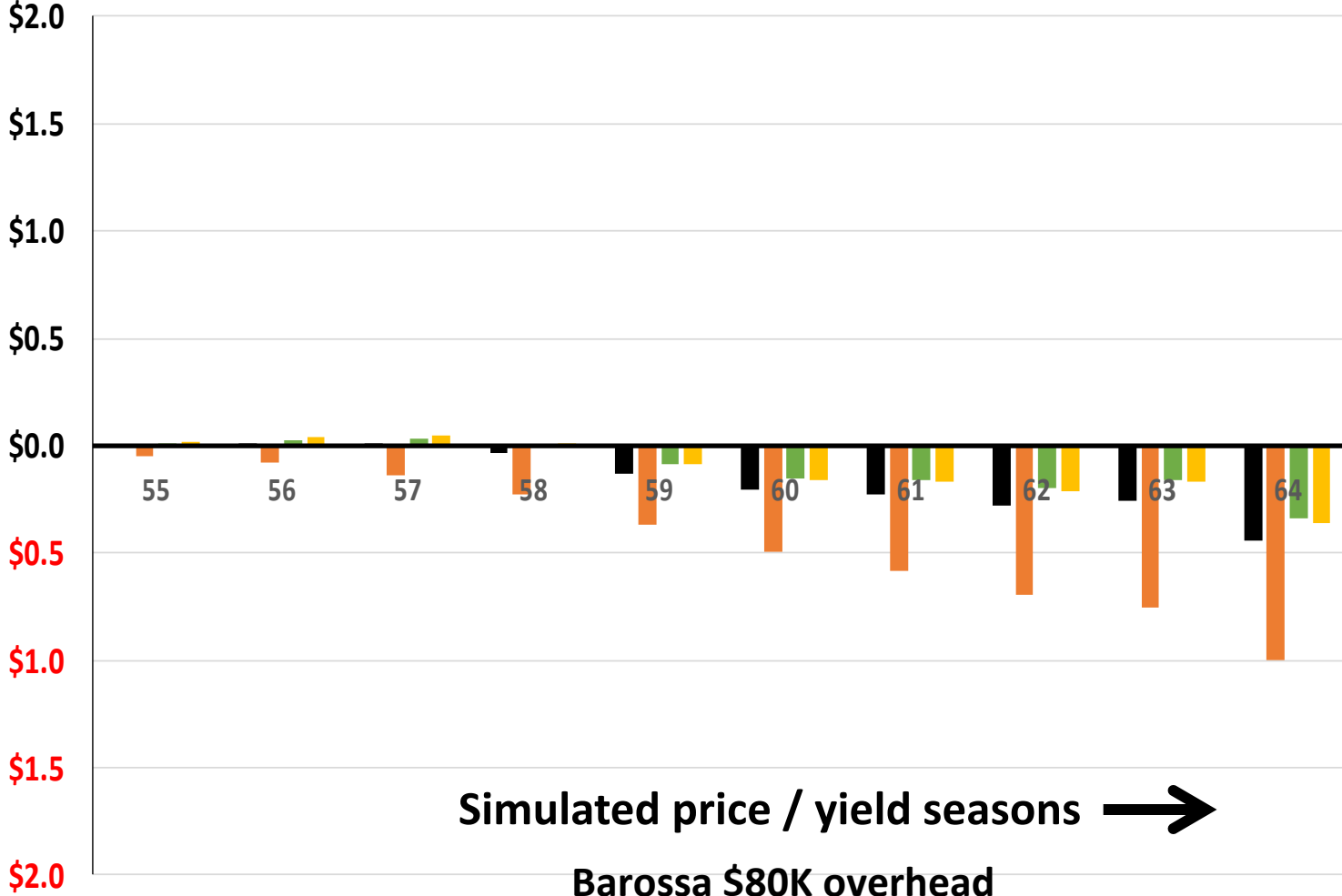


50 hectare vineyard

\$ Million

Decade 55

**Decadal
cash
flow
\$ Million**



- HERBICIDE **\$0.42**
- COCKSFOOT **\$0.98**
- BURR MEDIC **\$0.31**
- STRAW **\$0.34**

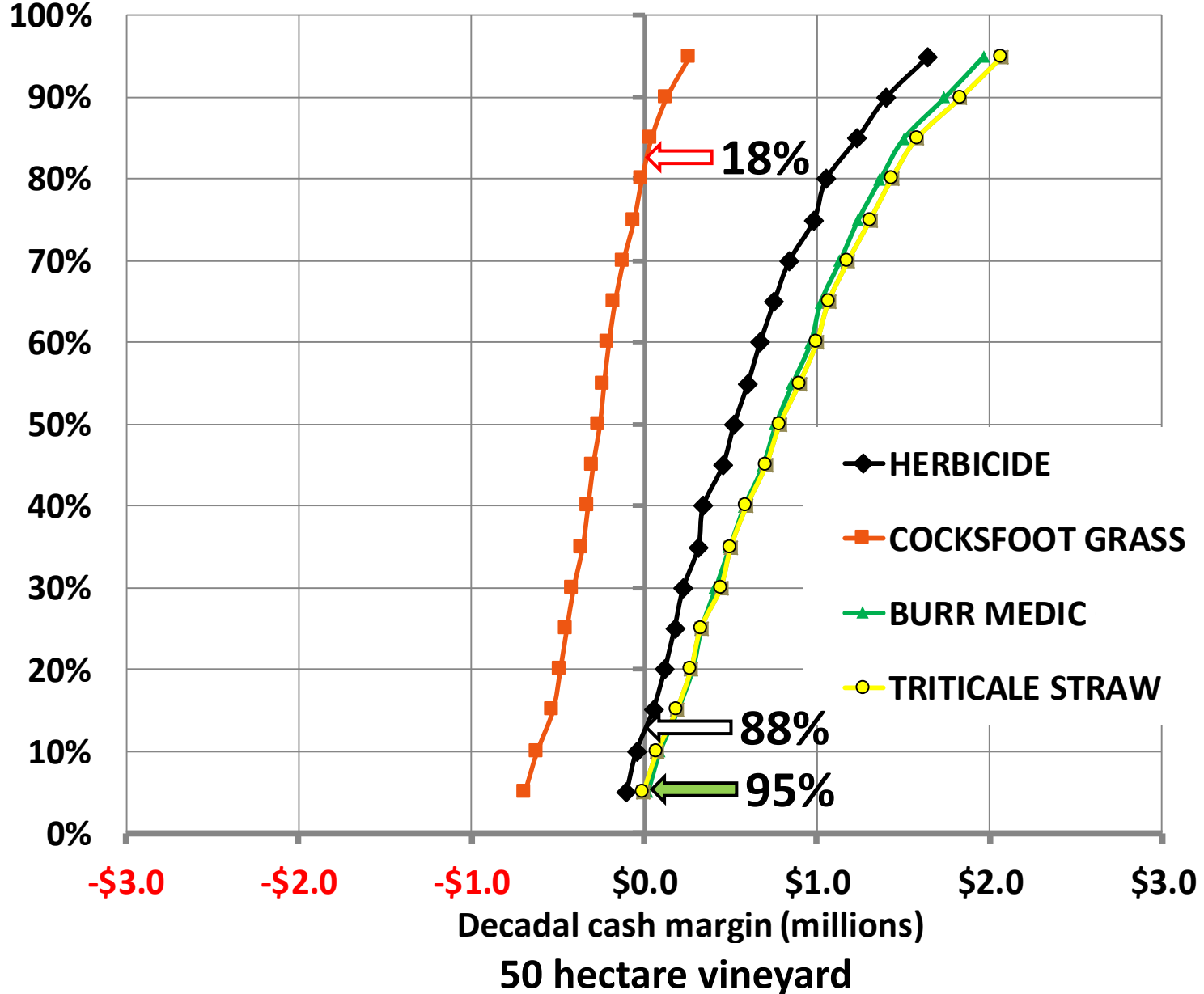
Simulated price / yield seasons →

Barossa \$80K overhead

50 hectare vineyard

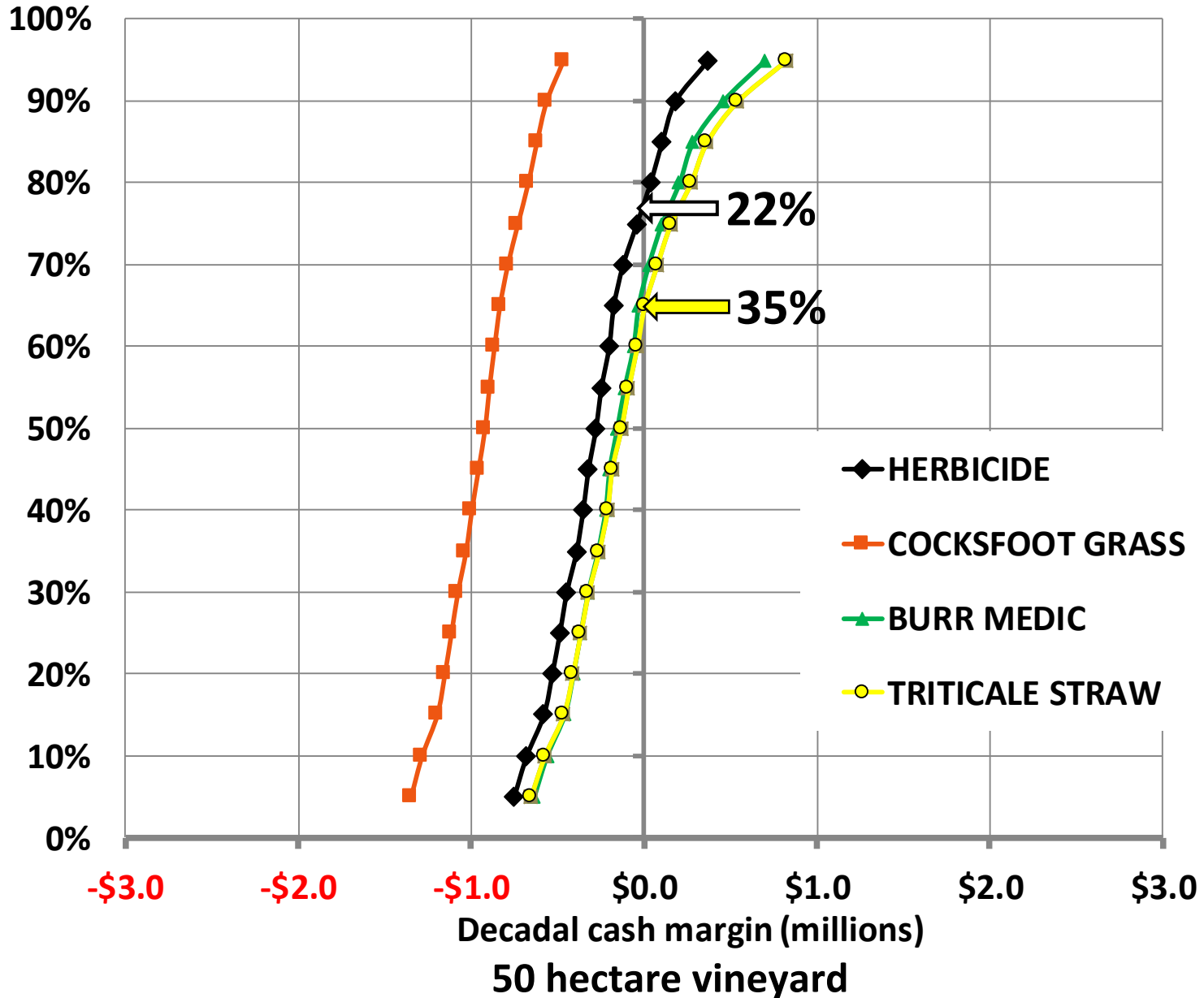
Cumulative probability

Barossa Shiraz, \$80K overhead



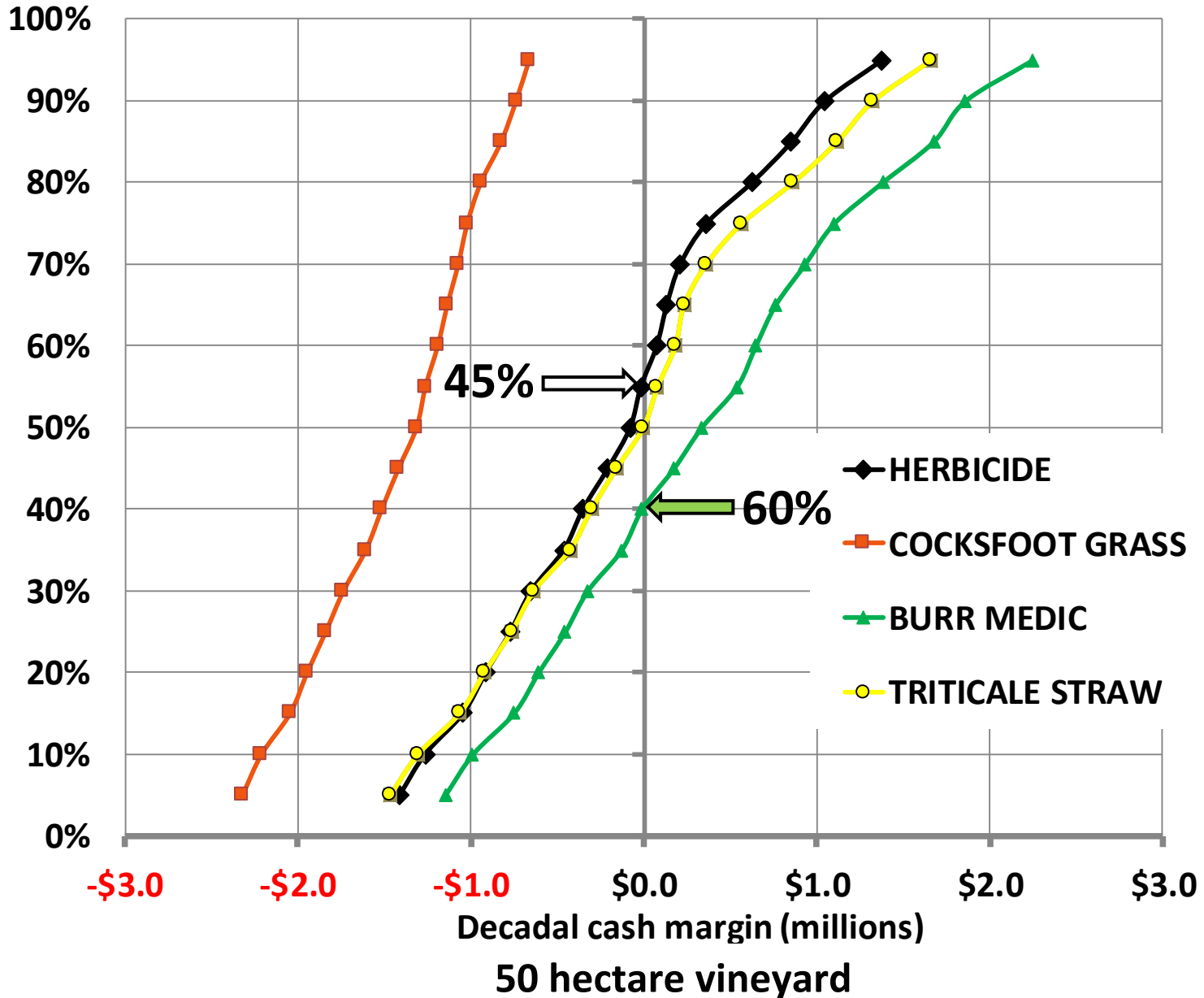
Cumulative probability

Barossa Shiraz, \$120K overhead



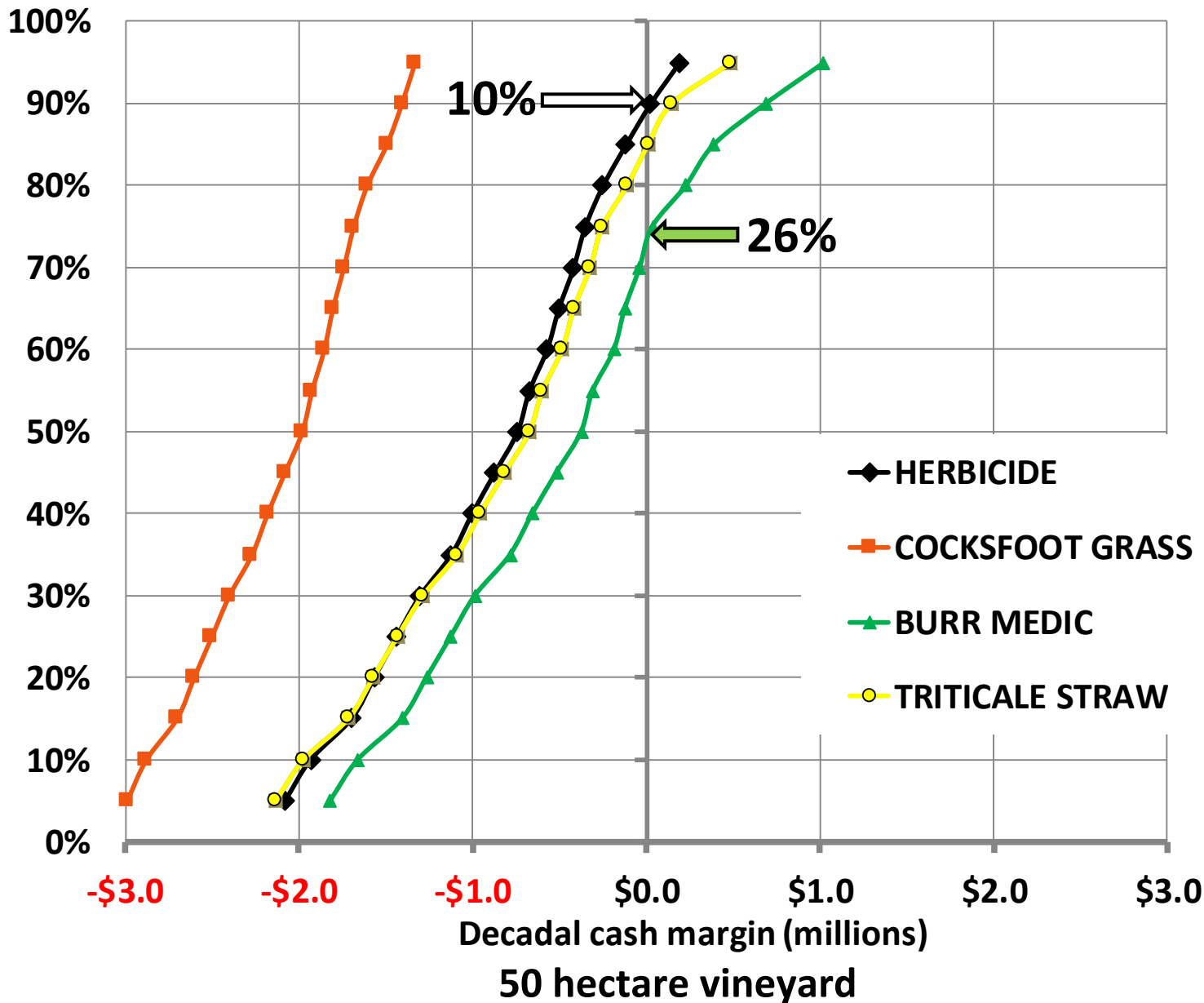
Cumulative probability

Langhorne Creek Cab-Sav, \$80K overhead

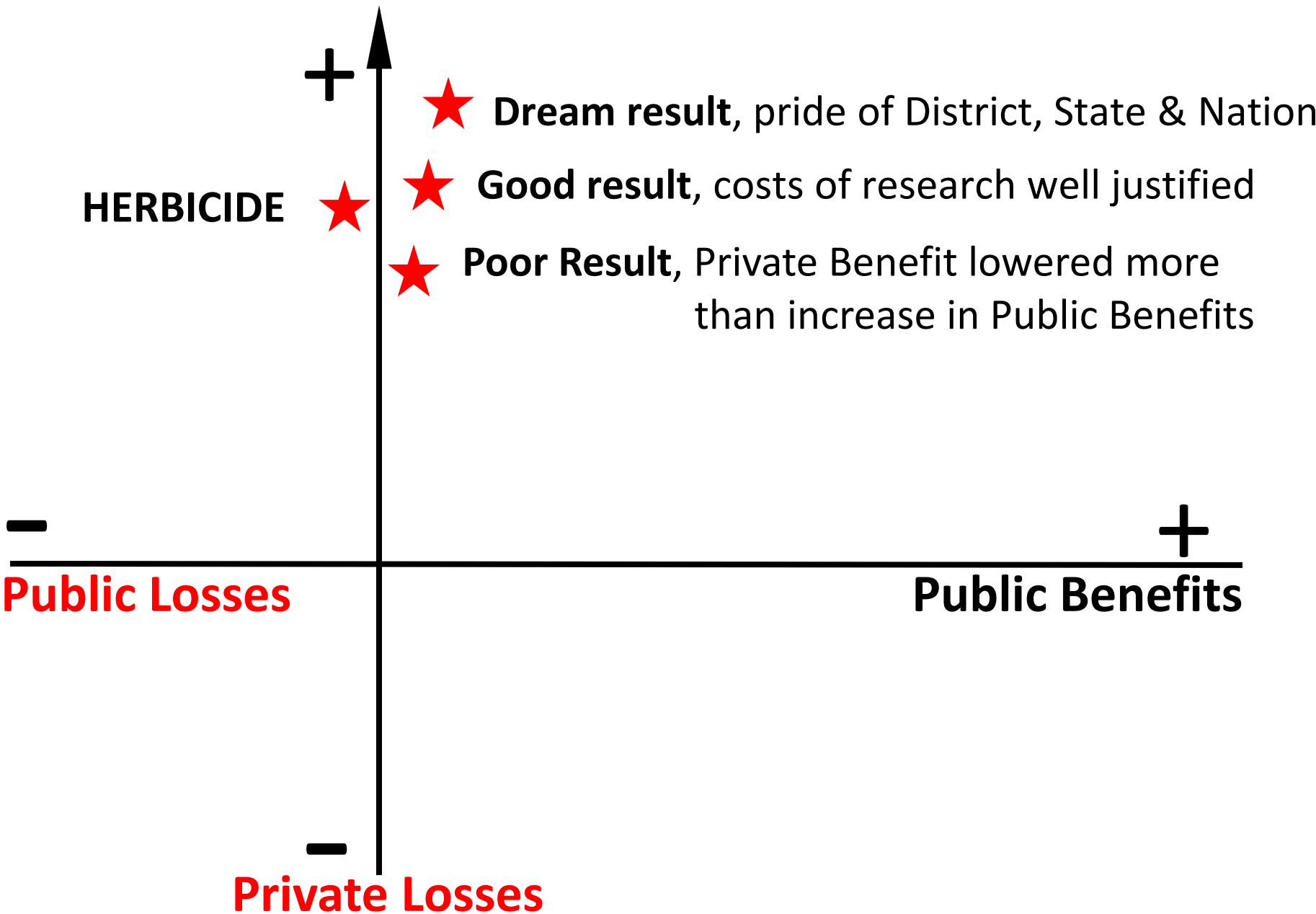


Cumulative probability

Langhorne Creek Cab-Sav, \$120K overhead



Private Benefits



Conclusions



Where herbicide resistance is not (yet) in evidence, the **rise of herbicide resistance implies the prudent course is to explore such options.**

If there are private **economic benefits from integrated weed management** using different control measures over time to maintain the efficacy of herbicides, most **will go to vineyard owners over time, justifying research levies they pay.**

Specific recommendations on plant species giving the best results from under-vine mulching **are likely to differ among districts** as weed populations, soils, climates, input costs and output prices differ. **Weed suppression is a key.**

At stake in the world marketplace is the fact that premiums are often paid for products guaranteed to be 'clean and green'. It is particularly **important to the image of Australian agricultural exports to maintain the verifiable reality of the claim of taste, safety and wholesomeness.**

- **Further seasons of field trial results at a larger sample of locations** are needed to improve and correct our initial inferences;
- **Review of our cost assumptions, which include higher costs for mulch options than the herbicide option;** i.e., is re-sowing a living mulch required every year?
- **Review our assumption of identical grape quality and prices across all under-vine treatments at a location.** Recent taste-panel results for samples from the treatments indicate differences, and **quality is key for winemakers.**
- **Prepare a more comprehensive economic analysis,** covering a greater diversity of locations with corrected cost, price and yield assumptions.

Things to do in the coming seasons



Acknowledgements

- **To Prof. Jim Pratley** , Graham Centre for Agricultural Innovation, Charles Sturt University, for discussions and references on herbicide resistance in weeds;
- **To Dr John D. Finlayson**, Whangaraei, New Zealand, for assistance in computing the extended jointly correlated random (stochastic) series of yields and prices for our risk analyses based on the statistical characteristics of a shorter historical series;
- **To Dr Tim Hutchings**, Meridian Agricultural Consulting, for help in the adaptation of his '***sequential multivariate analysis***' (SMA) model with @RISK software. This was used by the first author to generate the long-term, whole-farm financial risk profiles needed for the present analysis.