32nd Annual NATIONAL NO-TILLAGE CONFERENCE

January 9-12, 2024 • Indianapolis, Ind.

Working with Ag Startups

Clay Mitchell

$$NPV = \frac{cash\ flows}{(1+i)^t}$$

What happens when you double i

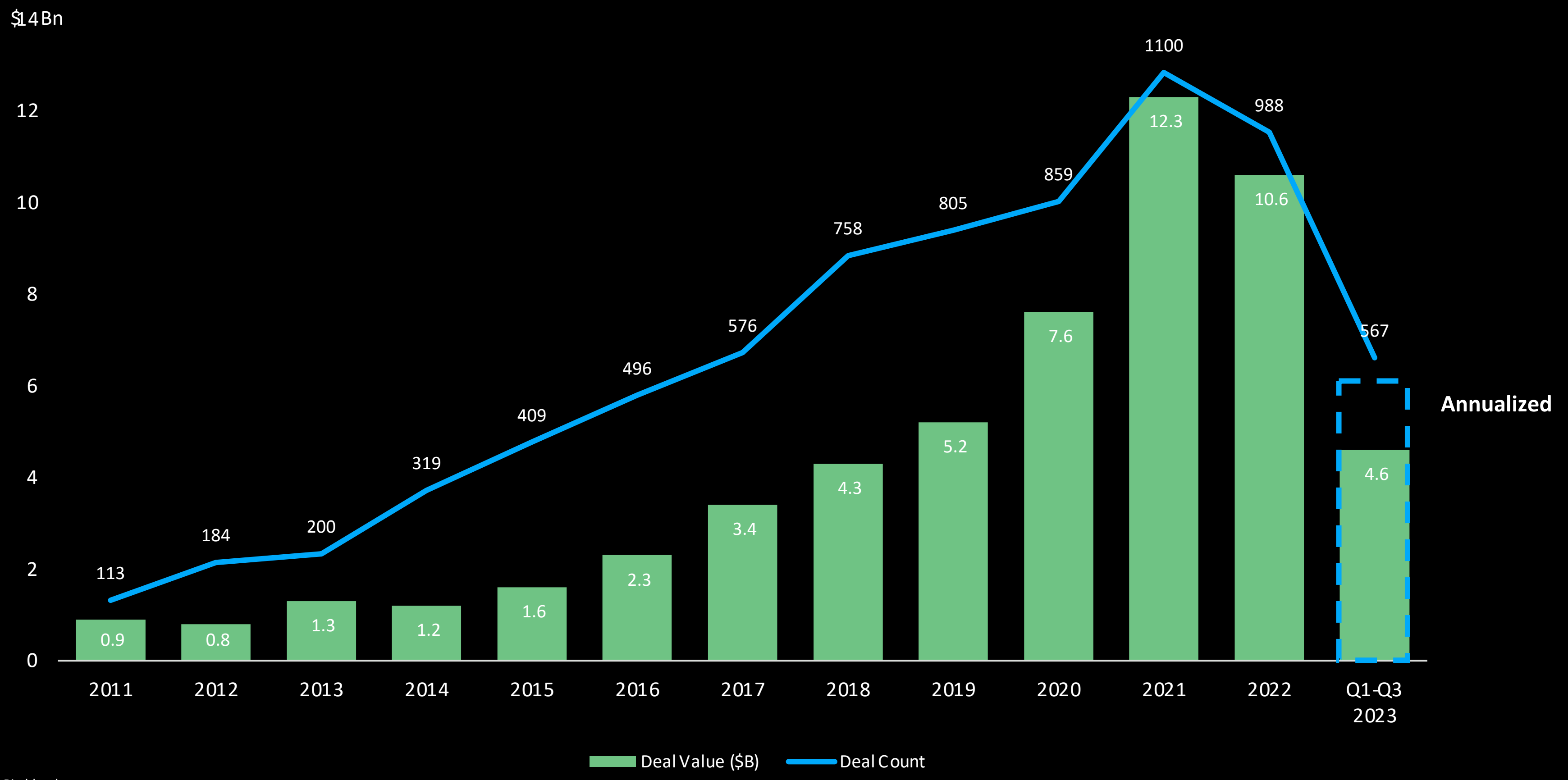
NPV of $100 for 1-8 years and at discount rates of 5-40%

YEARs

Rate

	1	2	3	4	5	6	7	8
5%	$95.24	$90.70	$86.38	$82.27	$78.35	$74.62	$71.07	$67.68
10%	$90.91	$82.64	$75.13	$68.30	$62.09	$56.45	$51.32	$46.65
15%	$86.96	$75.61	$65.75	$57.18	$49.72	$43.23	$37.59	$32.69
20%	$83.33	$69.44	$57.87	$48.23	$40.19	$33.49	$27.91	$23.26
25%	$80.00	$64.00	$51.20	$40.96	$32.77	$26.21	$20.97	$16.78
30%	$76.92	$59.17	$45.52	$35.01	$26.93	$20.72	$15.94	$12.26
35%	$74.07	$54.87	$40.64	$30.11	$22.30	$16.52	$12.24	$9.06
40%	$71.43	$51.02	$36.44	$26.03	$18.59	$13.28	$9.49	$6.78

AG & FOODTECH ACTIVITY MIRRORS GENERAL MARKET

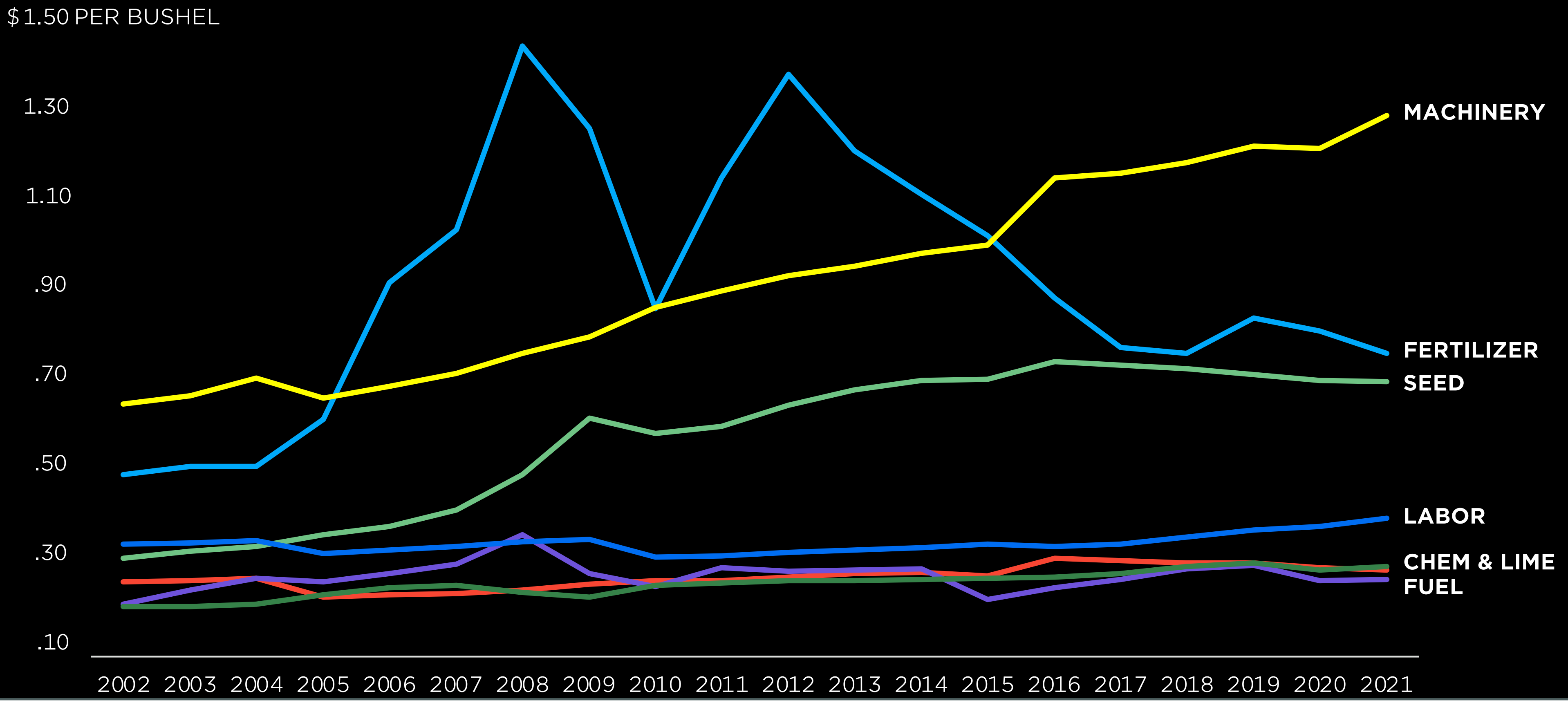


Source: Pitchbook

*Through September 2023

HISTORICAL TRENDS OF MAJOR CORN PRODUCTION COSTS

COST PER BUSHEL 2002-2021 CORN AT 150 BPA



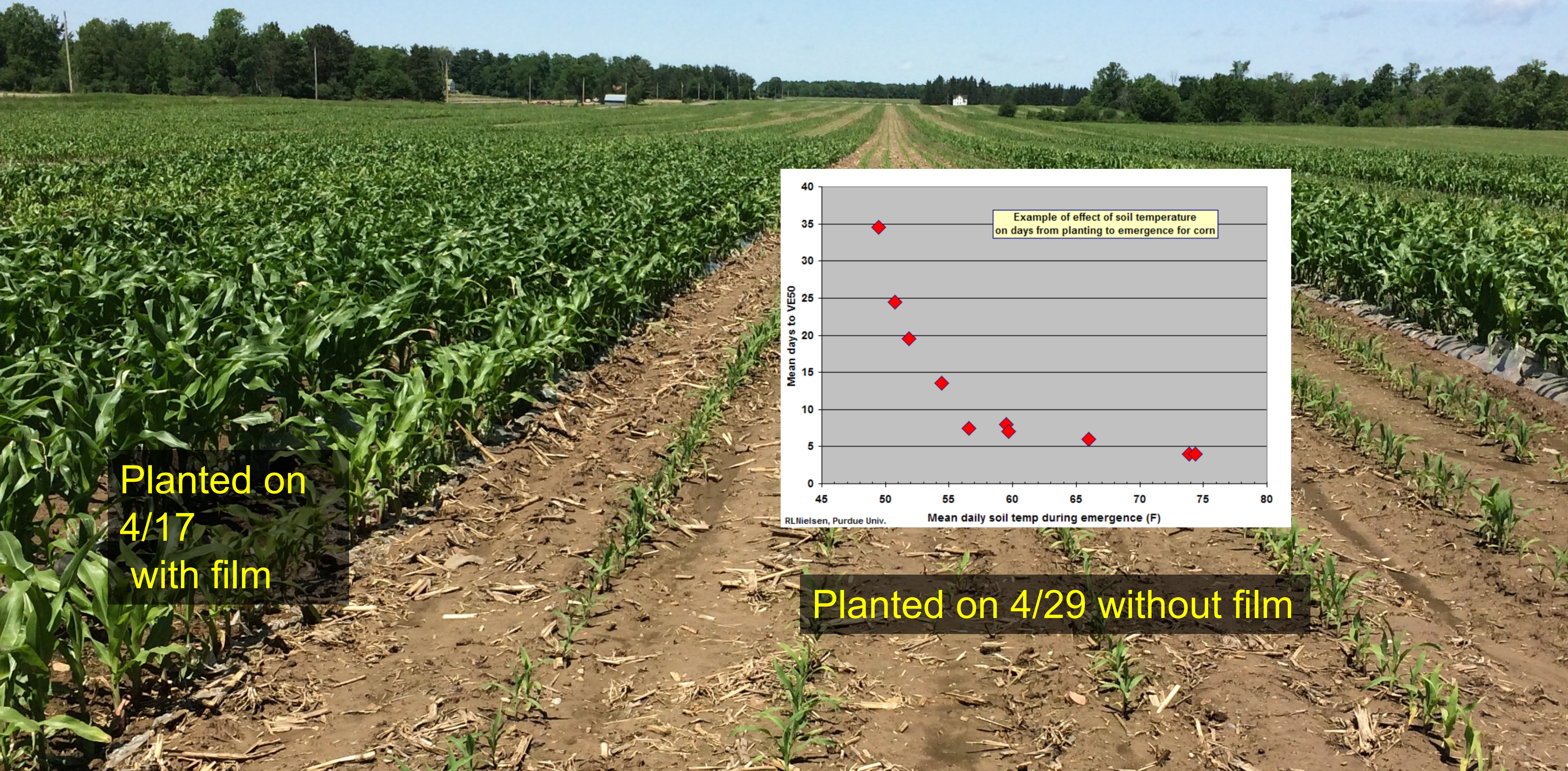
Source: USDA NASS, as of September 2022

Herrman, WI

MULCH FILM

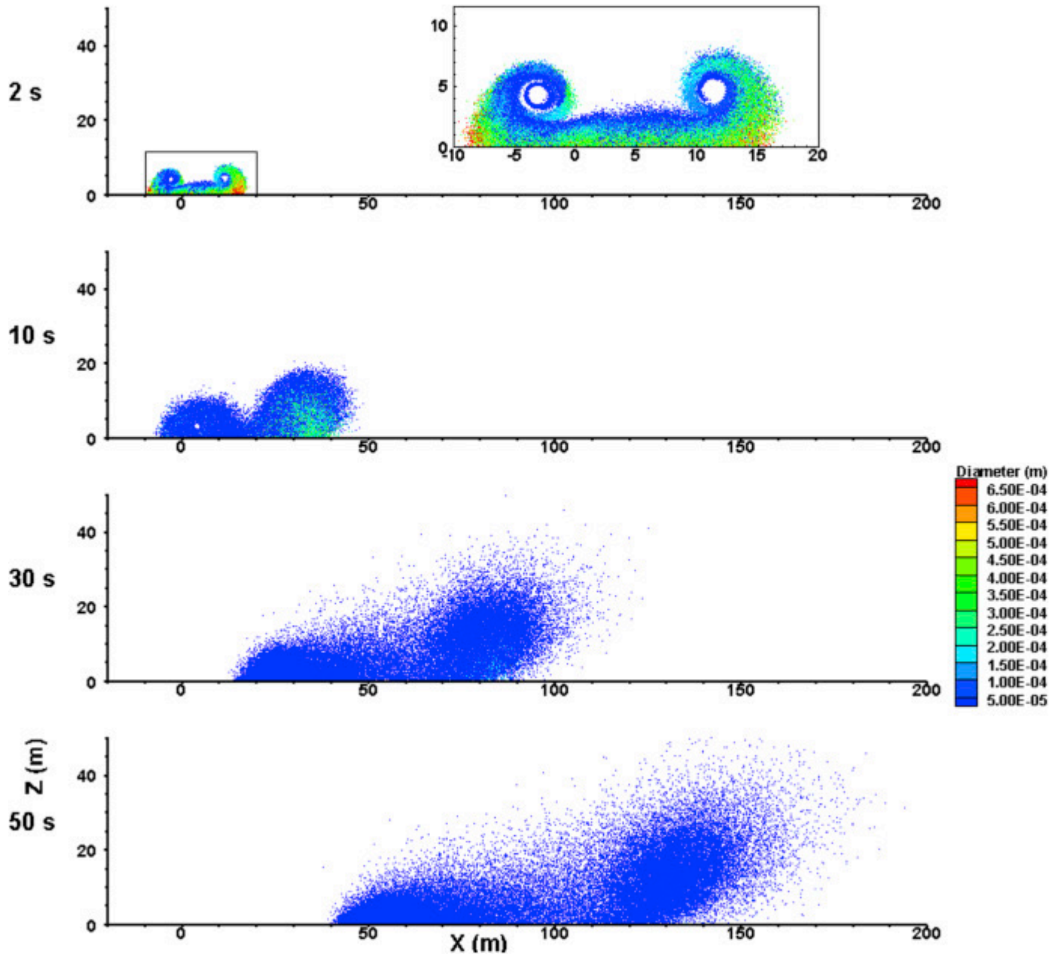
- Biodegradable
- Greenhouse effect – warms soil, speeds germination, retains moisture
- Frost protection – allows earlier planting
- Increases early season heat units
- Weed control

EARLY PLANTING WITH MULCH FILM



FACT: Aerial spray droplets are downsized by shear

Typical working speed of an Air Tractor is 130-160mph. At that speed it is impossible, even with adjuvants, to have droplets that don't get sheared into driftable fines smaller than 100 µm.



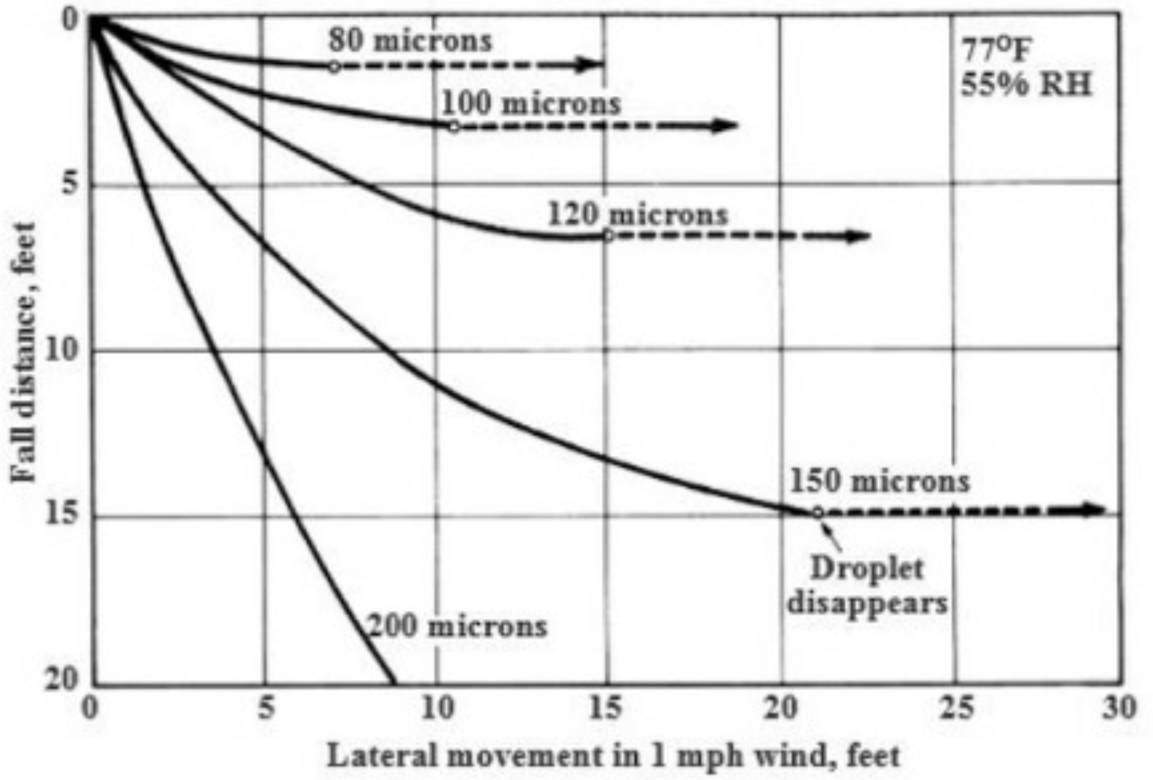
Vieira, B.C., Alves, G.S., Carvalho, F.K., Da Cunha, J.P.A., Antuniassi, U.R. and Kruger, G.R., 2018. Influence of airspeed and adjuvants on droplet size distribution in aerial applications of glyphosate. Applied Engineering in Agriculture, 34(3), pp.507-513.

FACT: Small droplets drift further

Sedimentation rate is proportional to the square of droplet diameter.

While a 1000 micron droplet drifting 4.7 feet in a 3mph wind from a release height of 10 feet, a 5 micron droplet will travel 3 miles under the same conditions.

Nuyttens, D., De Schampheleire, M., Verboven, P., Brusselman, E. and Dekeyser, D., 2009. Droplet size and velocity characteristics of agricultural sprays. Transactions of the ASABE, 52(5), pp.1471-1480..

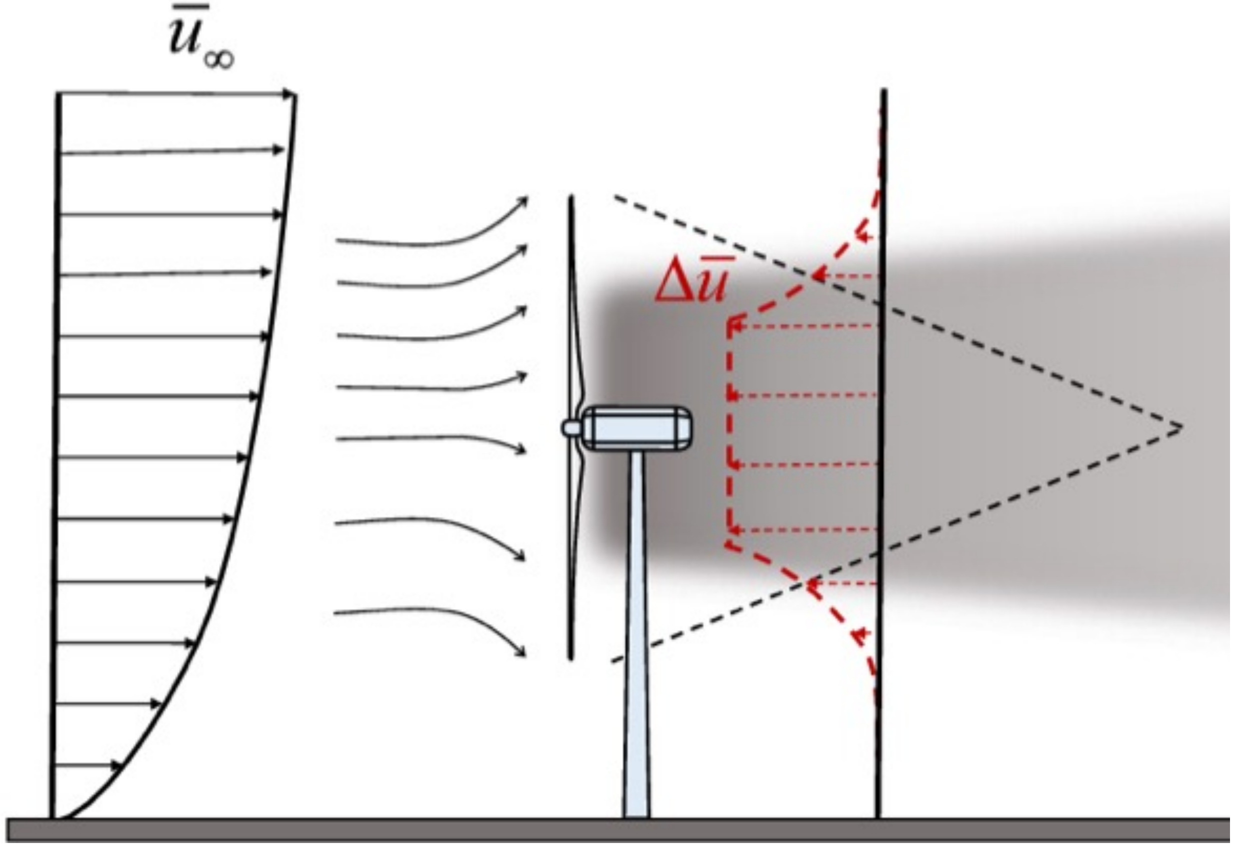


FACT: Wind speeds increase with height

Obvious to any casual observer, shear rate as a concept is also a fundamental feature of meteorology.

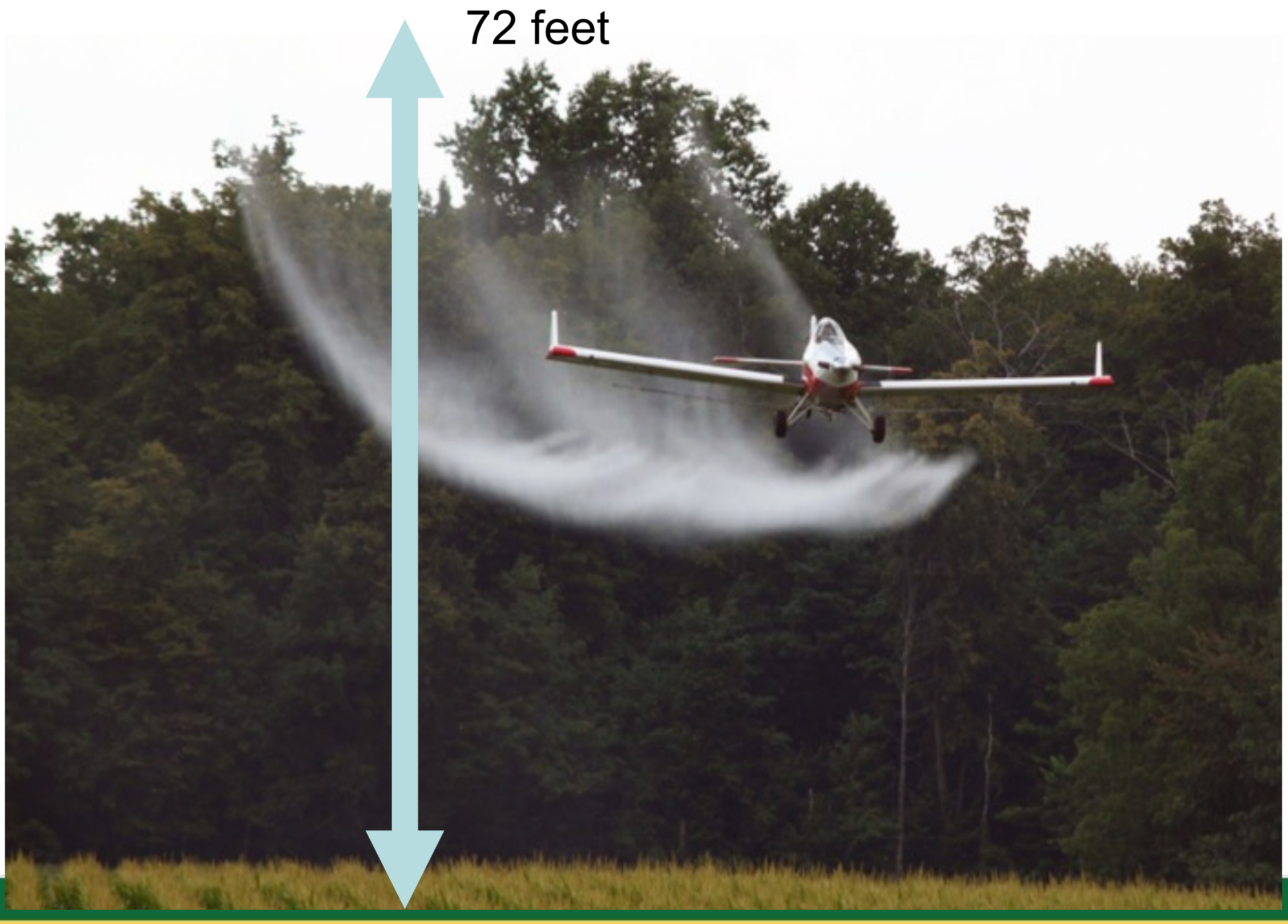
Empirical measurements have been motivated by wind farm design.

Rehman, S., Al-Hadhrami, L.M., Alam, M.M. and Meyer, J.P., 2013. Empirical correlation between hub height and local wind shear exponent for different sizes of wind turbines. *Sustainable Energy Technologies and Assessments*, *4*, pp.45-51.



FACT: Aerial release height is >5x ground

The aerial application industry quotes a standard release height of 8-12 feet, but airplanes commonly fly 20ft over uneven ground and begin application at >50ft when entering fields.



Teske, M.E., Bowers, J.F., Rafferty, J.E. and Barry, J.W., 1993. FSCBG: An aerial spray dispersion model for predicting the fate of released material behind aircraft. *Environmental Toxicology and Chemistry: An International Journal*, *12*(3), pp.453-464.

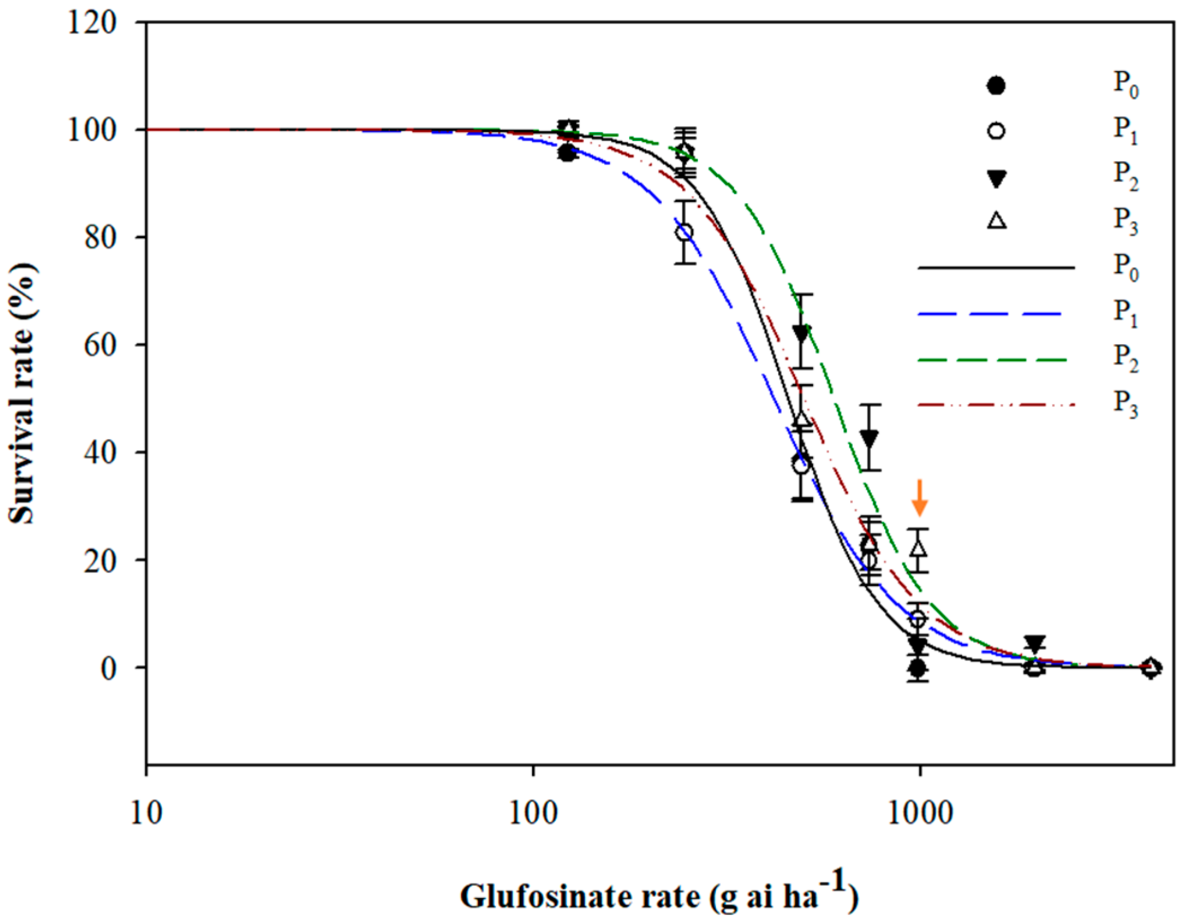
FACT: Aerial applicators spray border areas

Spraying of herbicides is typically done over field roads, ditches, and border areas.

As-Applied Maps

FACT: 3 yrs of recurrent selection creates resistance

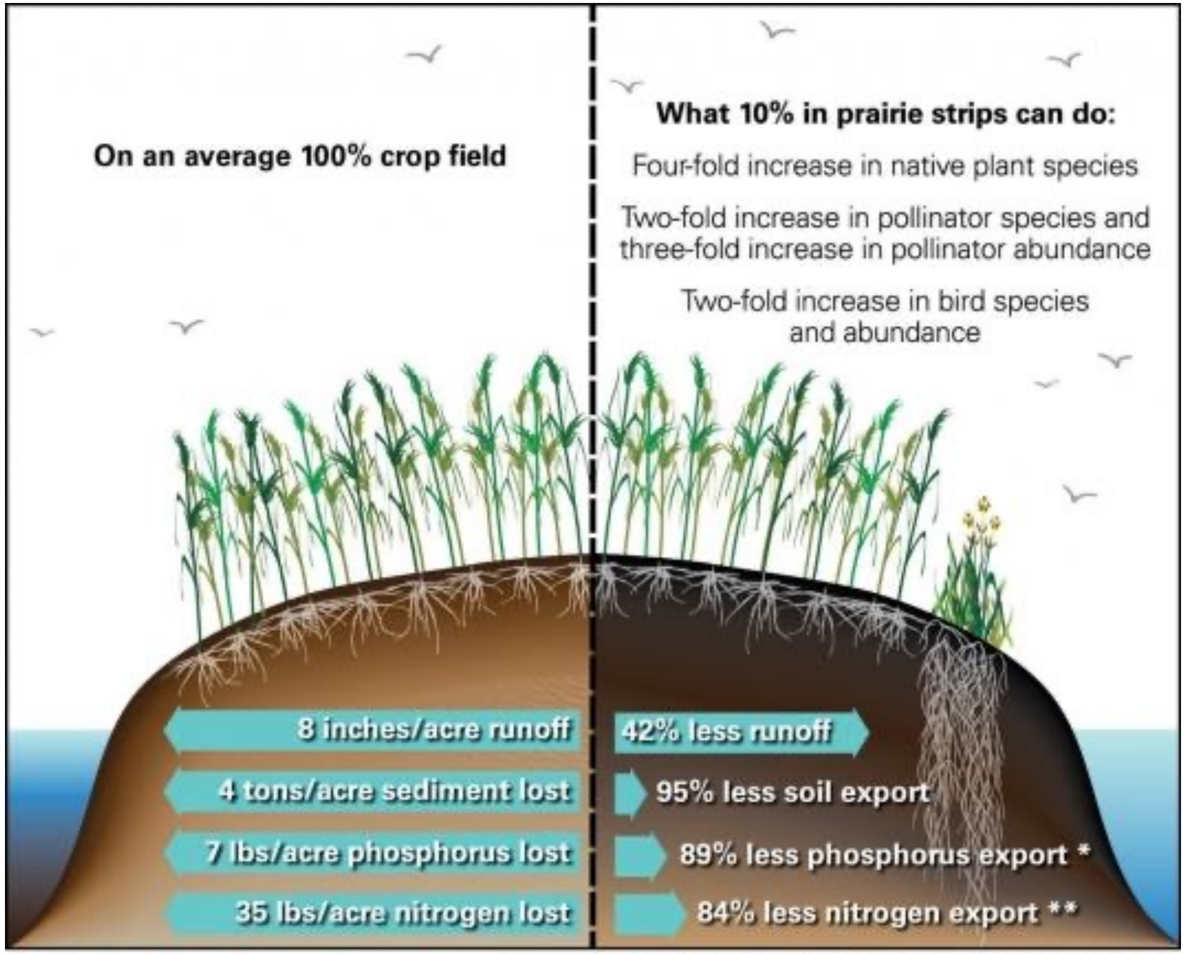
Multiple studies with commonly used herbicides have shown that only 3 years of sublethal doses will make non-resistant populations resistant.



Busi, R., Gaines, T.A., Walsh, M.J. and Powles, S.B., 2012. Understanding the potential for resistance evolution to the new herbicide pyroxasulfone: field selection at high doses versus recurrent selection at low doses. Weed Research, 52(6), pp.489-499.

FACT: Field border vegetation stops >95% of erosion

In properly managed fields, grassed borders, particularly around ditches, are the filter that prevents sediment and the fertilizer and chemicals attached to it from leaving fields.



Source: STRIPS Research Team and Leopold Center for Sustainable Agriculture

Grudens-Schuck, N., Helmers, M.J., Youngquist, T. and Johnson, M.S., 2017. Prairie strips for sediment and nutrient control and biodiversity. Journal of Extension, 55(1), p.1TOT6

The Andersons
HOLGANIX Soil Nourishing Root Stimulating
APACHE SPRAYERS ET
ForGround by Bayer
LAFORGE
GS3 QUALITY SEED
CopperheadAg PRODUCTS
Martin Till
Great Plains "Harvest Starts Here."
Sound

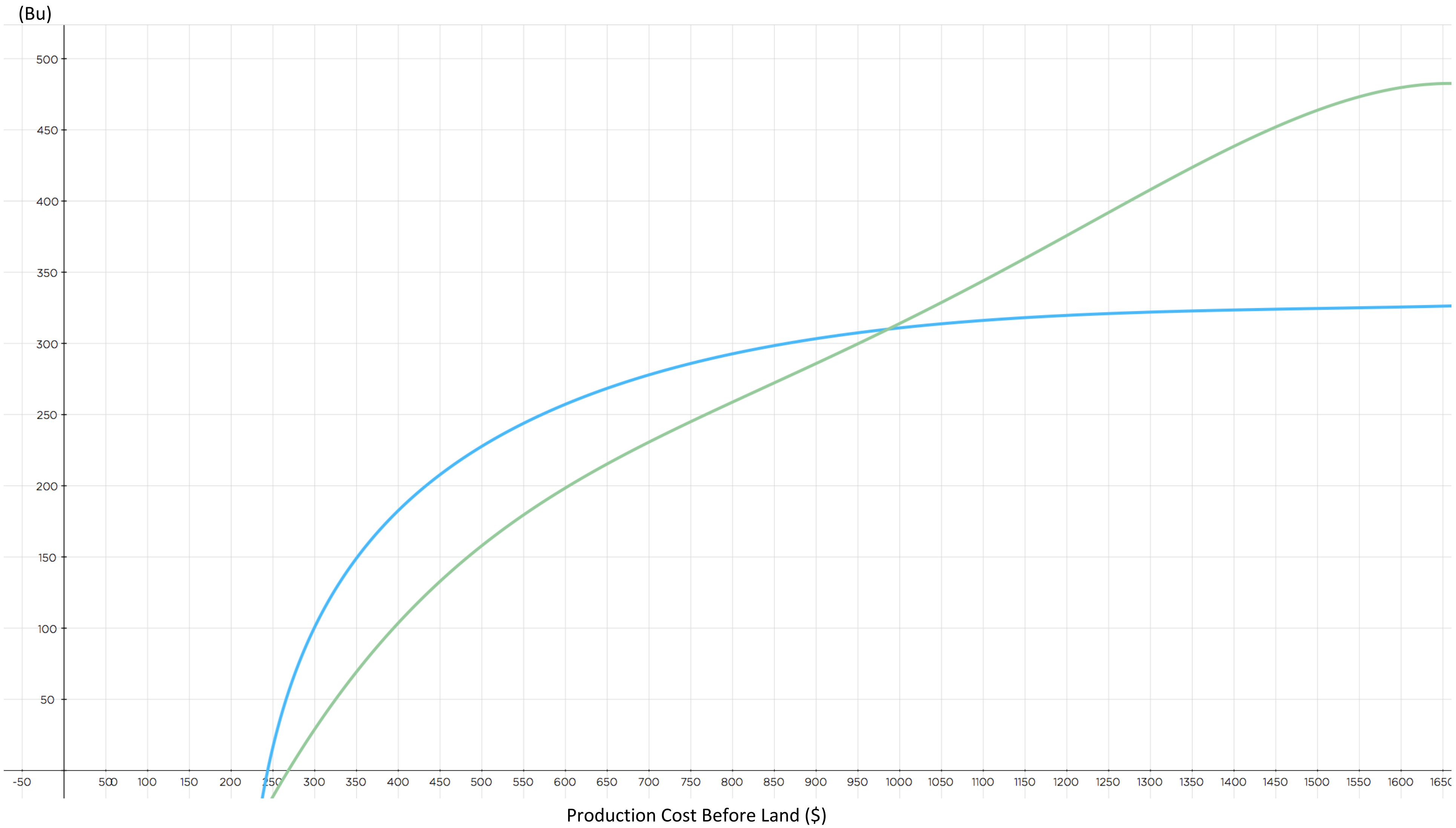
Quackers Farm, AR

Ball Road Farm, MS

Shubuta Farm, MS

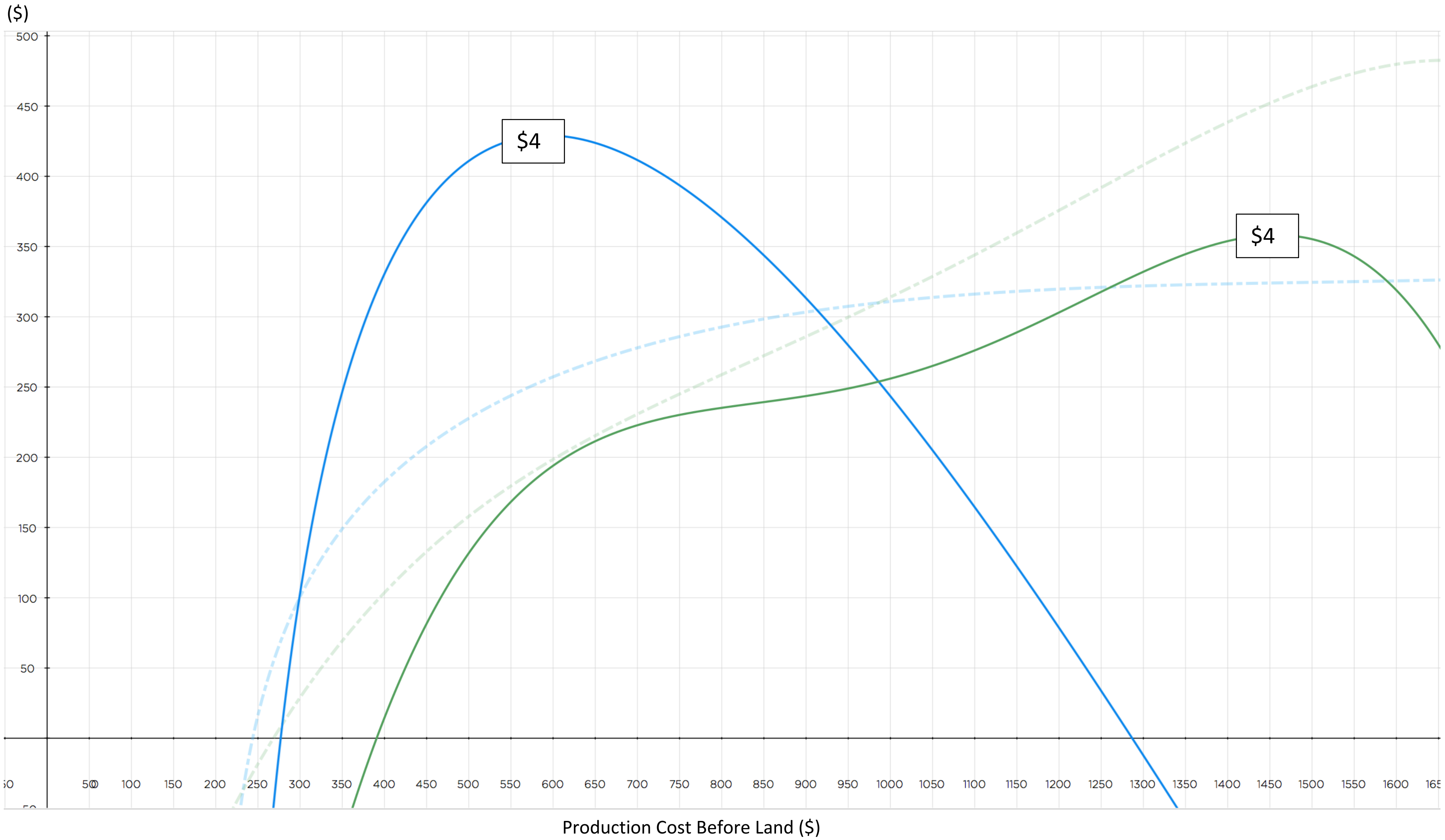
Corn Yield As Function of Total Production Cost

Mississippi vs Iowa, per acre

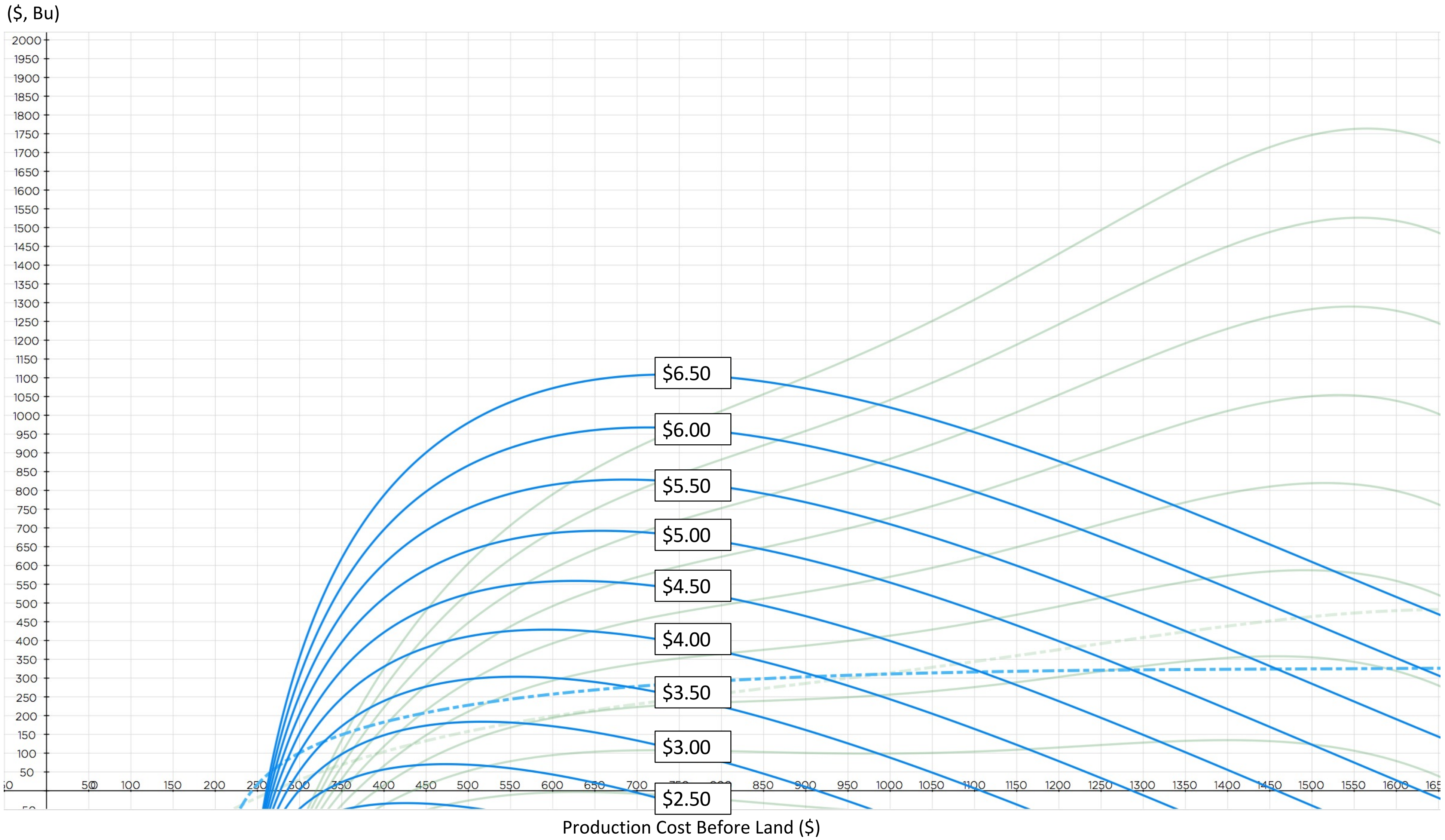


Net Farm Income as Function of Production Costs

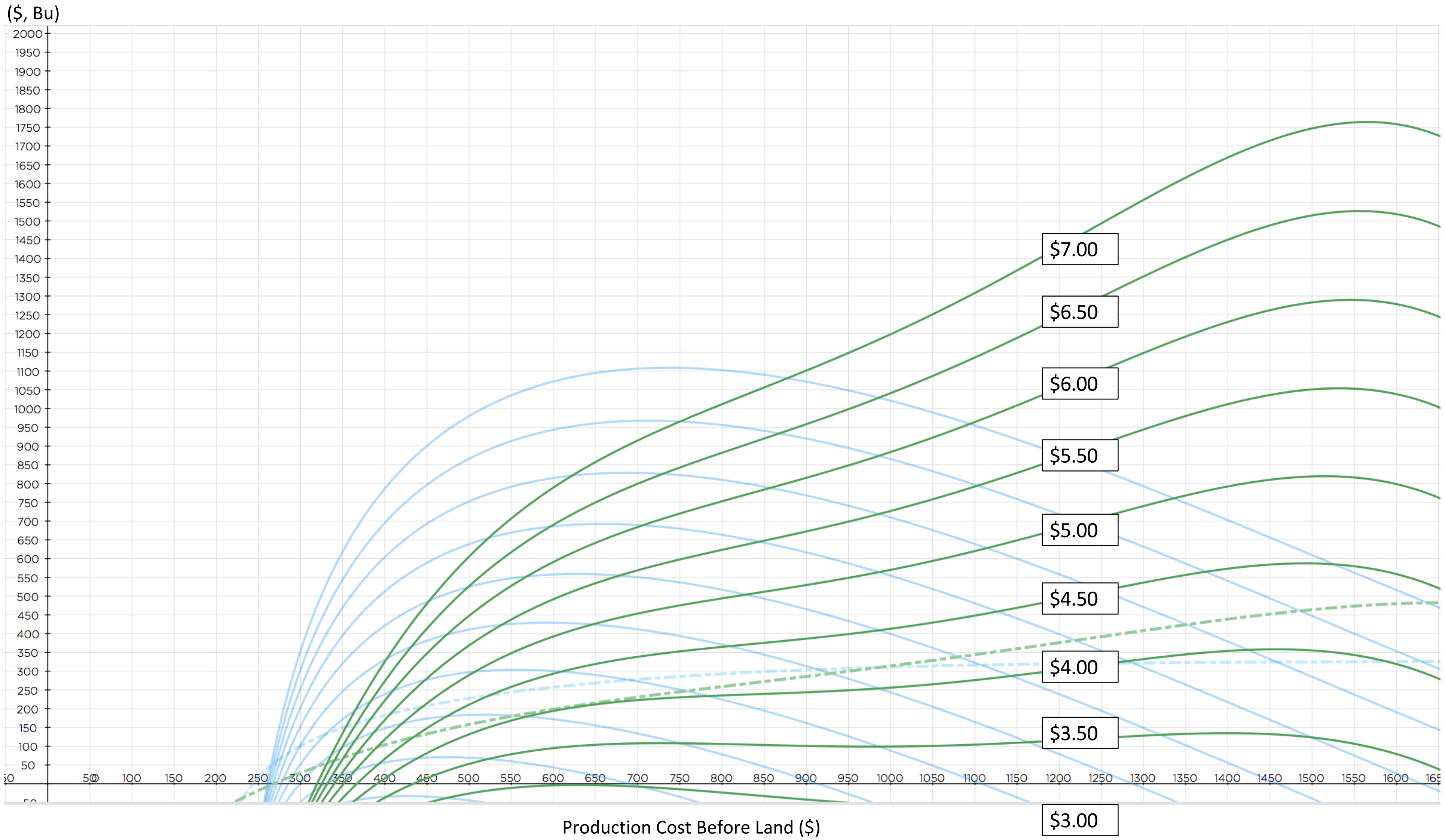
Mississippi vs Iowa, per acre



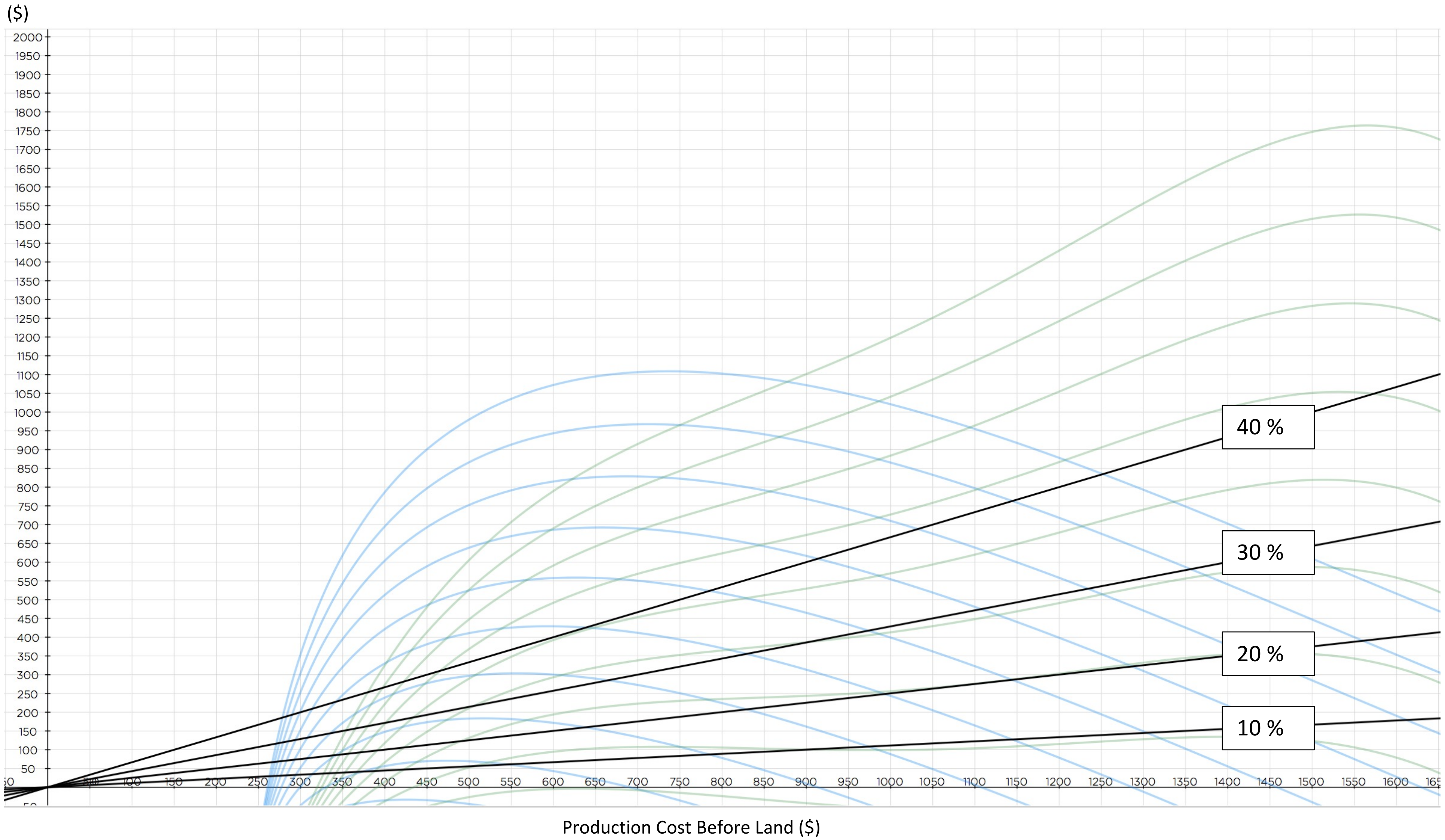
Iowa Yield and Income vs Production Cost Dynamics



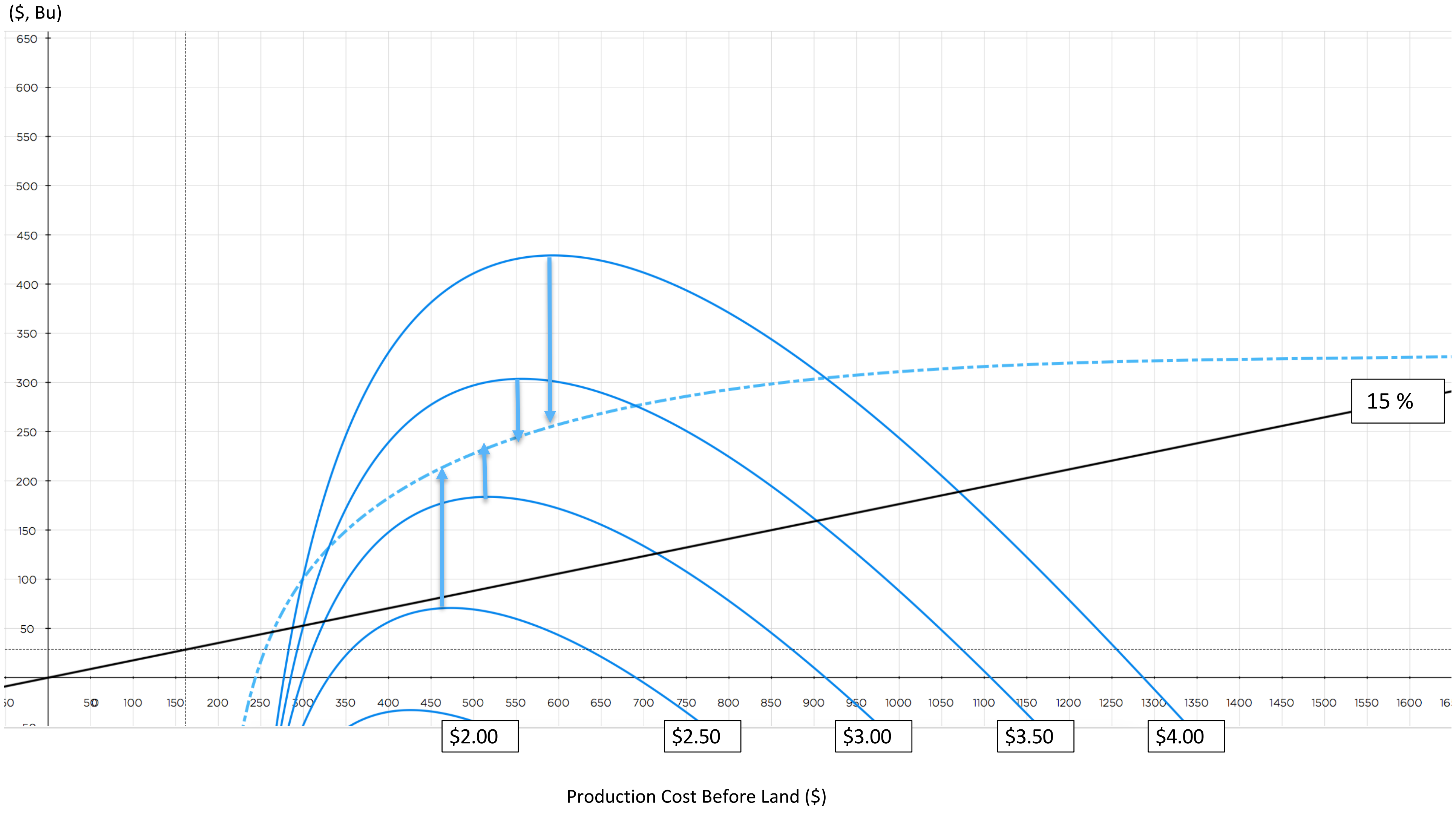
Mississippi Yield and Income vs Production Cost Dynamics



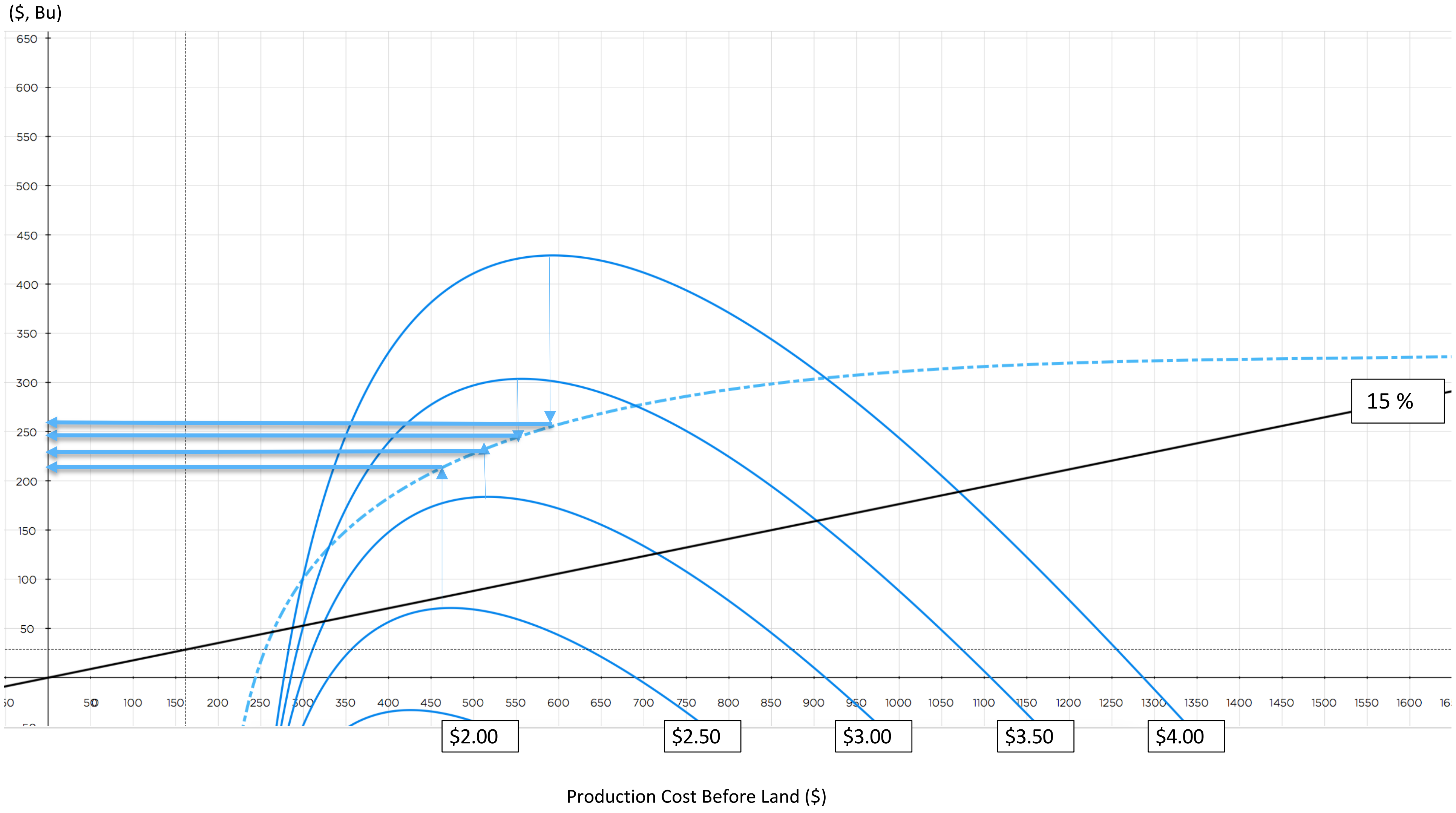
Operating Margin Before Land Costs



Iowa Farmland As a Stack of Corn Call Options

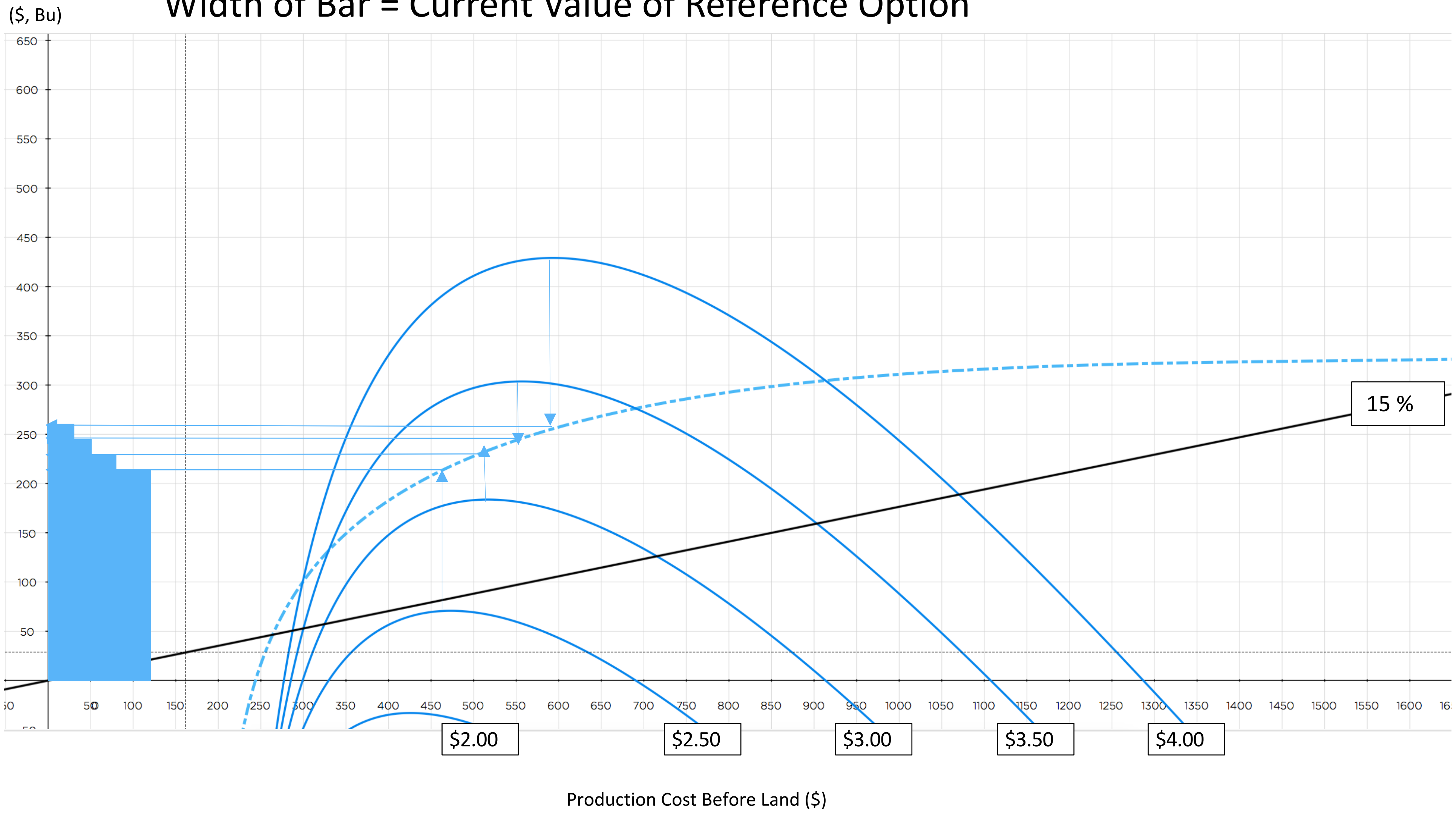


Iowa Farmland As a Stack of Corn Call Options

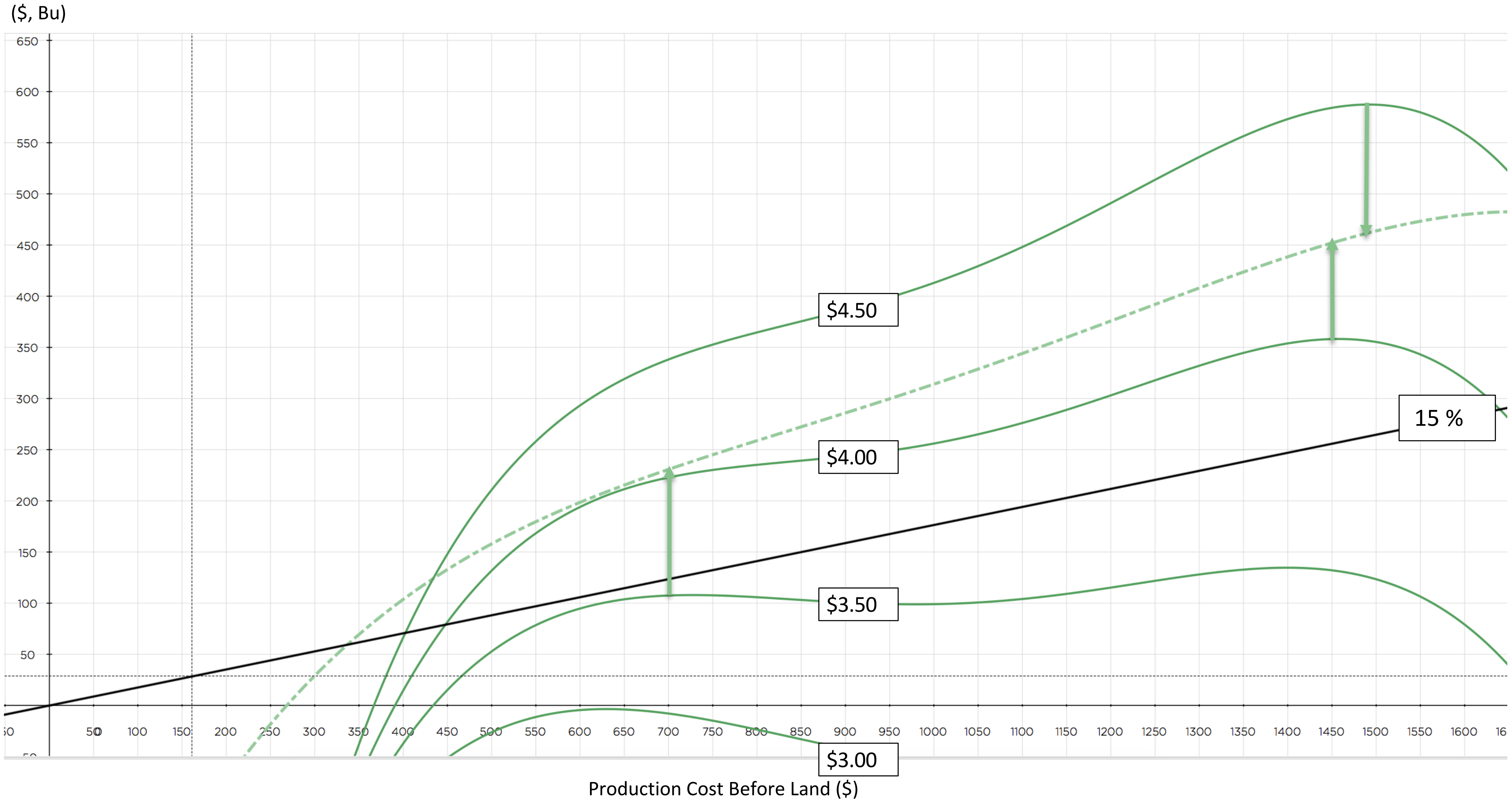


Iowa Farmland As a Stack of Corn Call Options

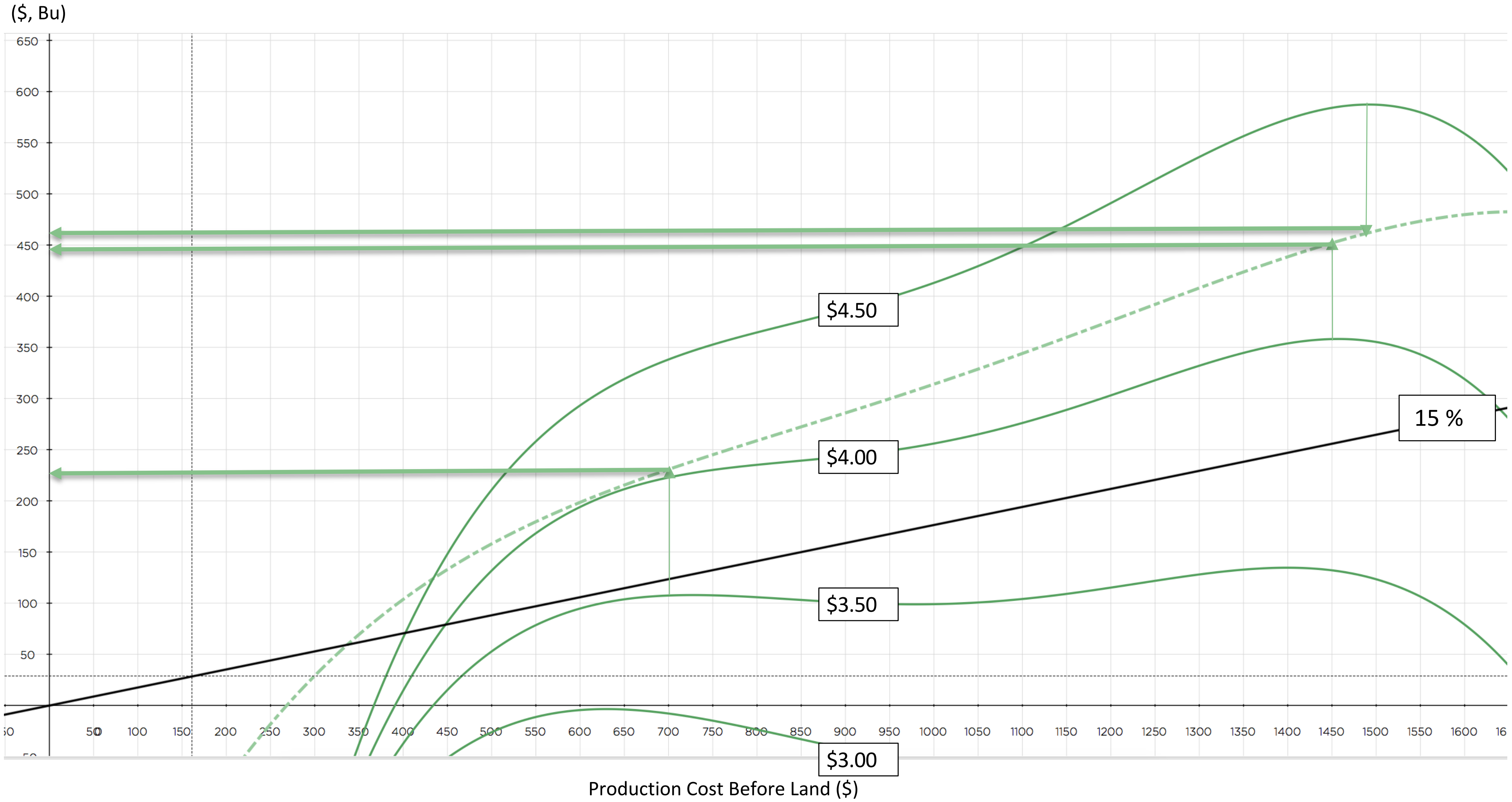
Reference Options: December CME Corn
Width of Bar = Current Value of Reference Option



Mississippi Farmland As a Stack of Corn Call Options



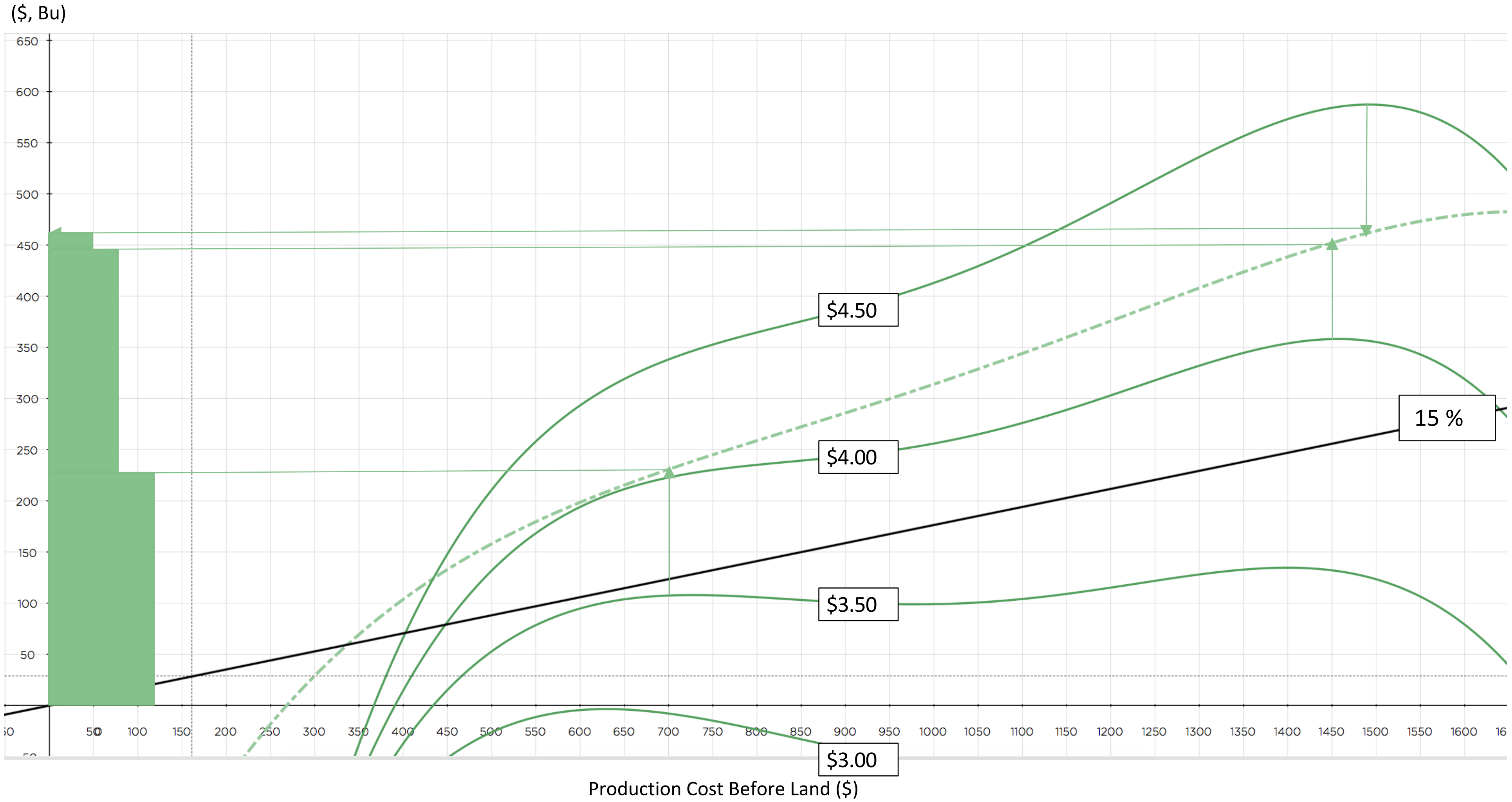
Mississippi Farmland As a Stack of Corn Call Options



Mississippi Farmland As a Stack of Corn Call Options

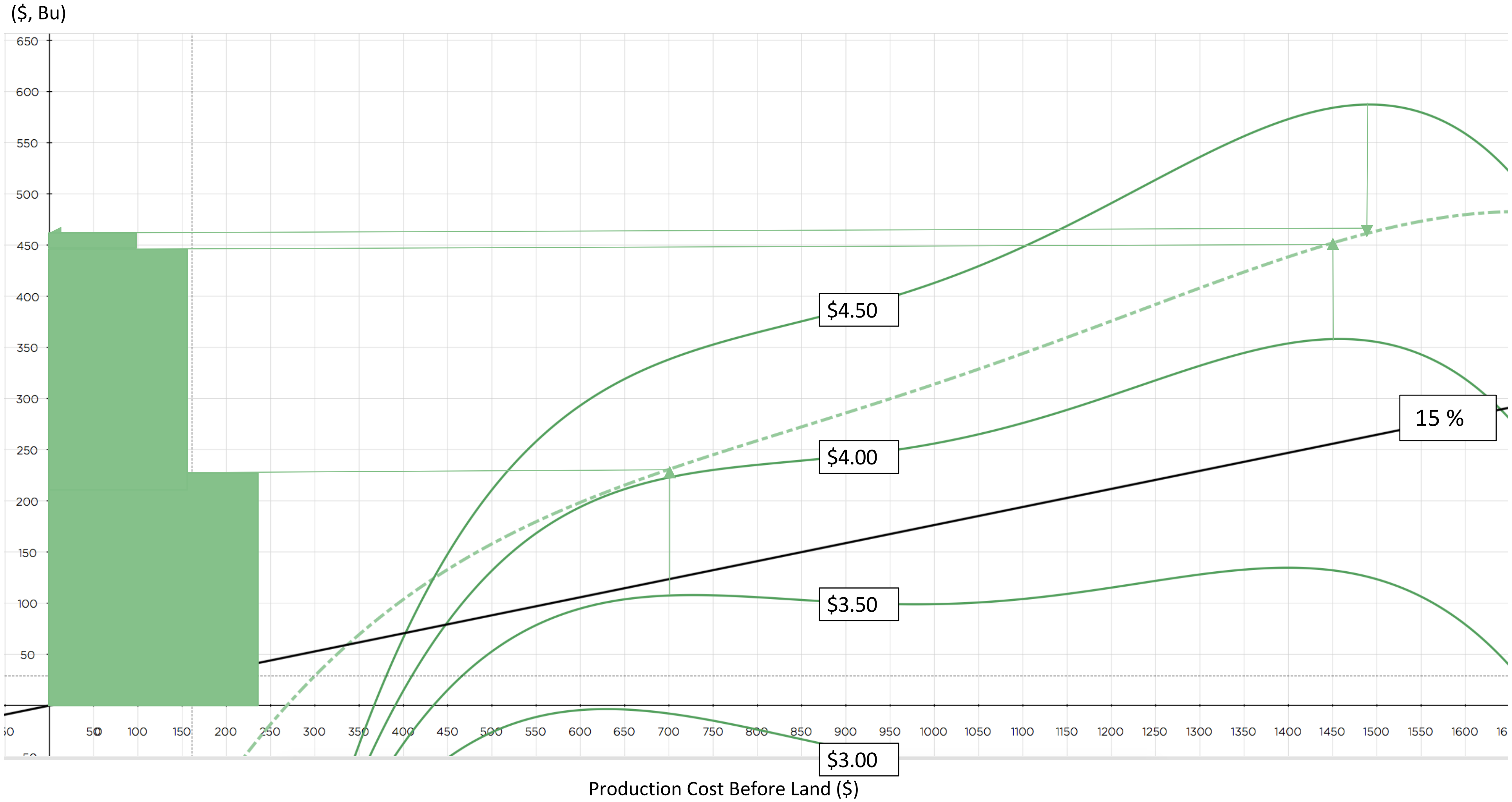
Reference Options: December CME Corn

Width of Bar = Current Value of Reference Option



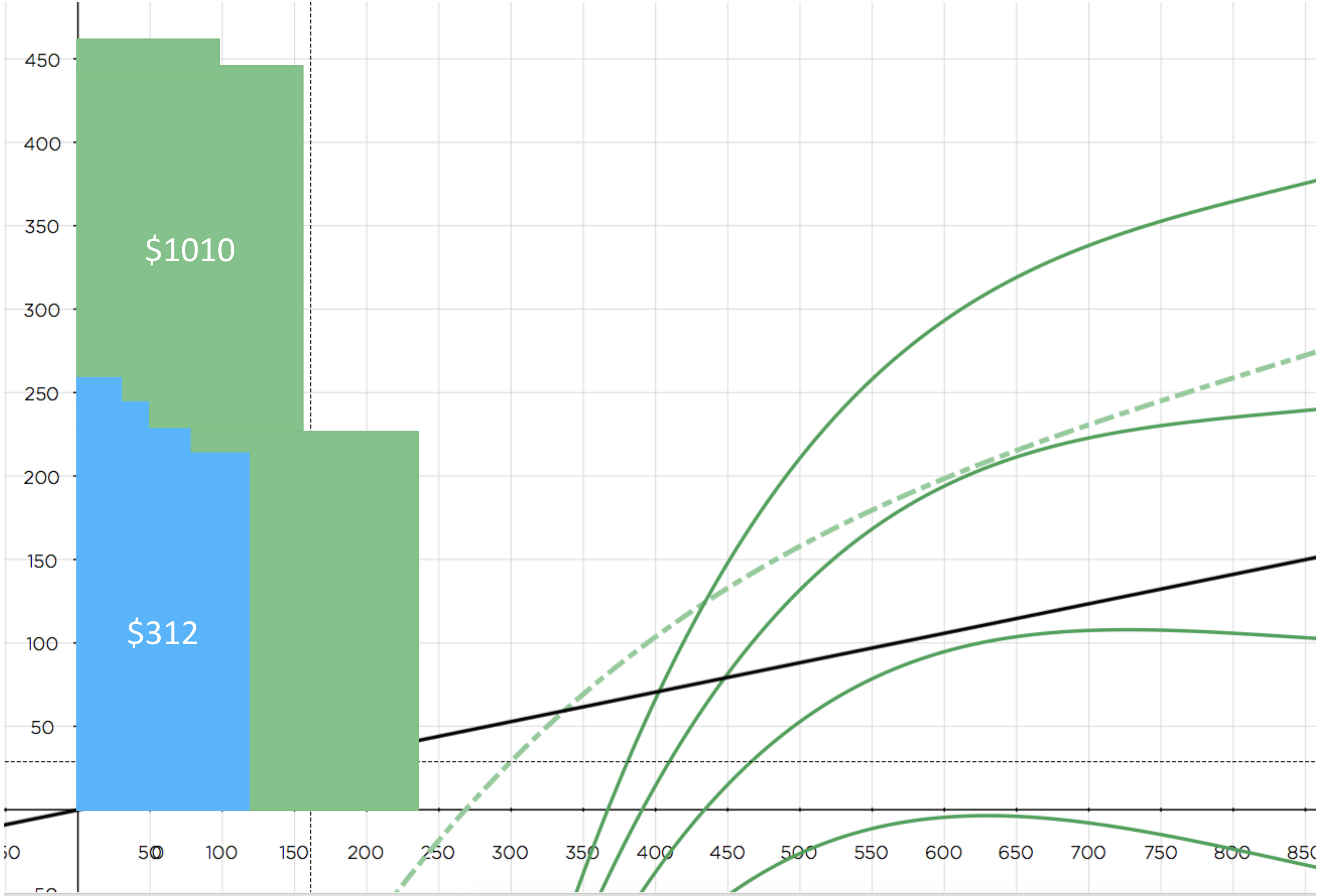
Mississippi Farmland As a Stack of Corn Call Options

Farmland Price Adjustment: Double the Option Stack



Mississippi vs Iowa, Current Value of Production Options

Per $10,000 of Farmland




Canyon, OR

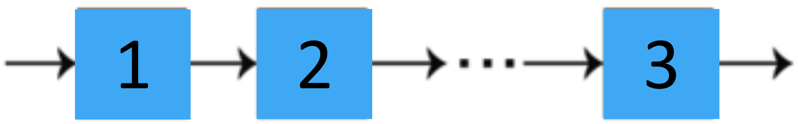

Brooksfield, MS


Canyon, OR

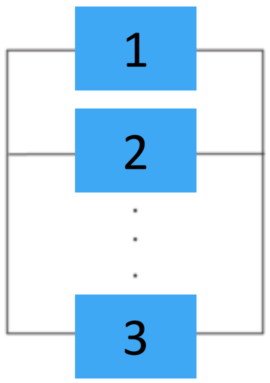

Yellowstone, MT

COMPONENT CONFIGURATIONS

- Series Systems
    - A failure of any component results in the failure of the entire system
    - All units must succeed for the system to work



- Simple Parallel Systems
    - At lease one unit must succeed for the system to succeed
    - Adding component (“redundancy”) improves system reliability



IMPROVING SYSTEM RELIABILITY

- Calculating reliability of a Series System
  - 3 Components: R1, R2, R3
  - Reliability:
    - R1 = 70%
    - R2 = 80%
    - R3 = 90%
    - R = 0.7 x 0.8 x 0.9 = 0.5 (50%) -> The reliability drops quickly!

- How do we improve the reliability most efficiently?
  - We added 10% reliability to each component:

The highest reliability was achieved when R1, which is the least reliable component, was increased by a value of 10%.

R1	R2	R3	R (System)
0.7	0.8	0.9	0.504
0.8	0.8	0.9	0.576
0.7	0.9	0.9	0.567
0.7	0.8	0.99	0.555

IN A SIMPLE PARALLEL SYSTEM, IT'S DIFFERENT!

- At least one component must succeed for the system to succeed -> In other words, to fail a Simple Parallel System, ALL components must fail
- Calculating reliability of a Parallel System
  - R1 = 60%
  - R2 = 70%
  - R3 = 80%
  - R = 1 - (1-0.6) x (1-0.7) x (1-0.8) = 0.976 (97.6%) -> The reliability improves!
- Improve the reliability most efficiently in Parallel System:

R1	R2	R3	R (System)
0.6	0.7	0.8	0.976
0.7	0.7	0.8	0.982
0.6	0.8	0.8	0.984
0.6	0.7	0.9	0.988

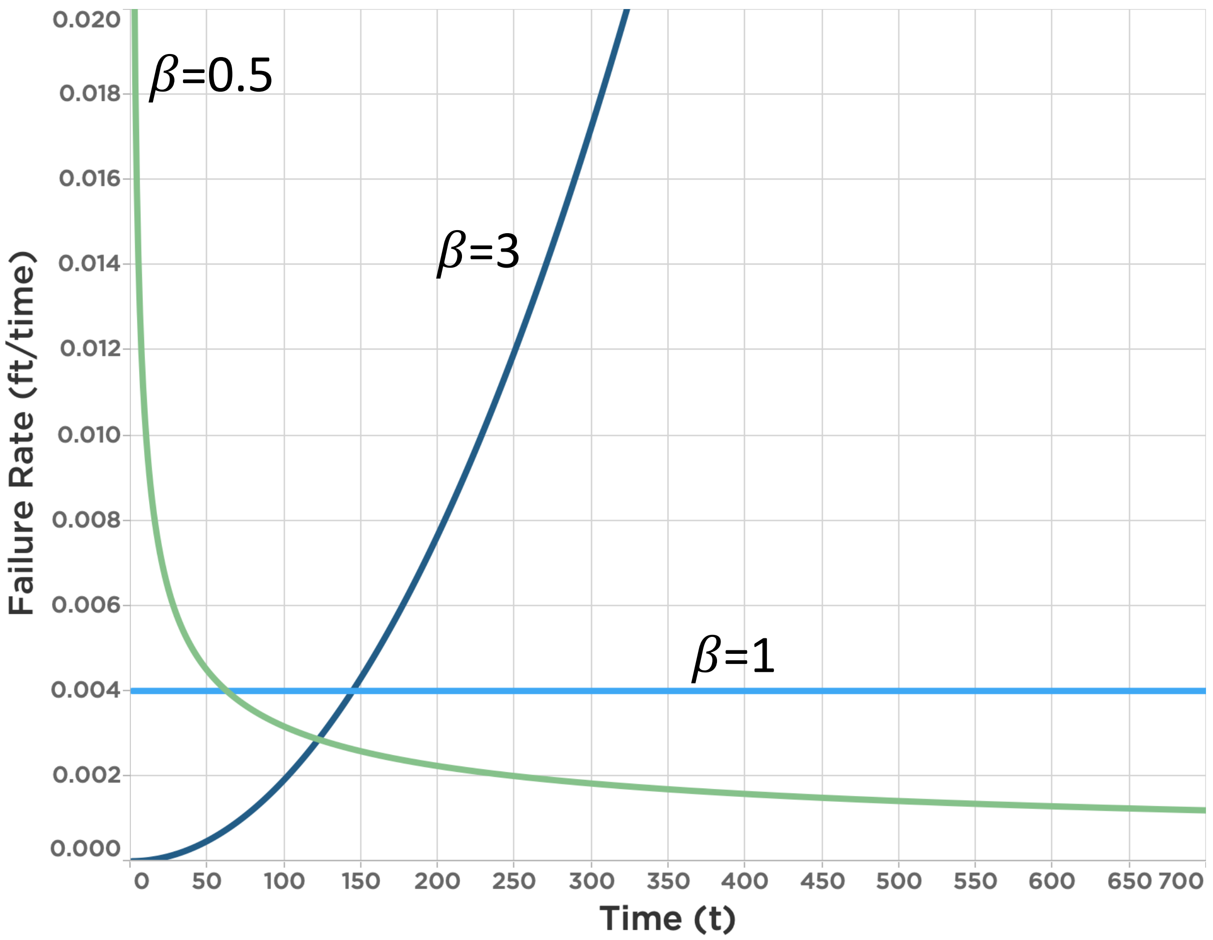
The highest reliability was achieved when R3, which is the most reliable component, was increased by a value of 10%.

THE WEIBULL DISTRIBUTION

$$f(T) = \frac{\beta}{\eta}\left(\frac{T}{\eta}\right)^{\beta-1} e^{-\left(\frac{T}{\eta}\right)^{\beta}}$$

$\boldsymbol{\eta}$ = scale parameter, or characteristic life
$\boldsymbol{\beta}$ = shape parameter (or slope)

WEIBULL FAILURE RATE

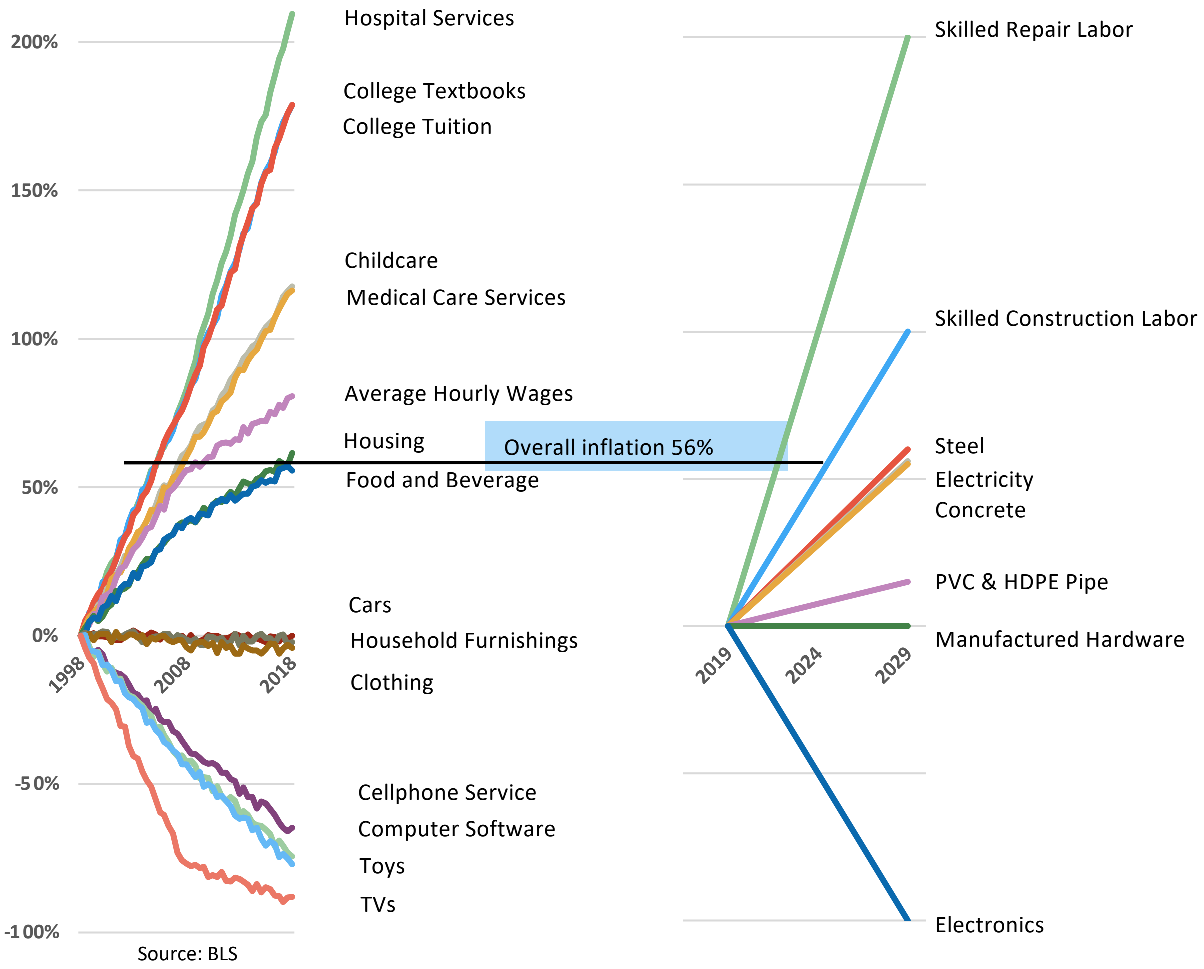


OPTIMAL ASSET LIFE

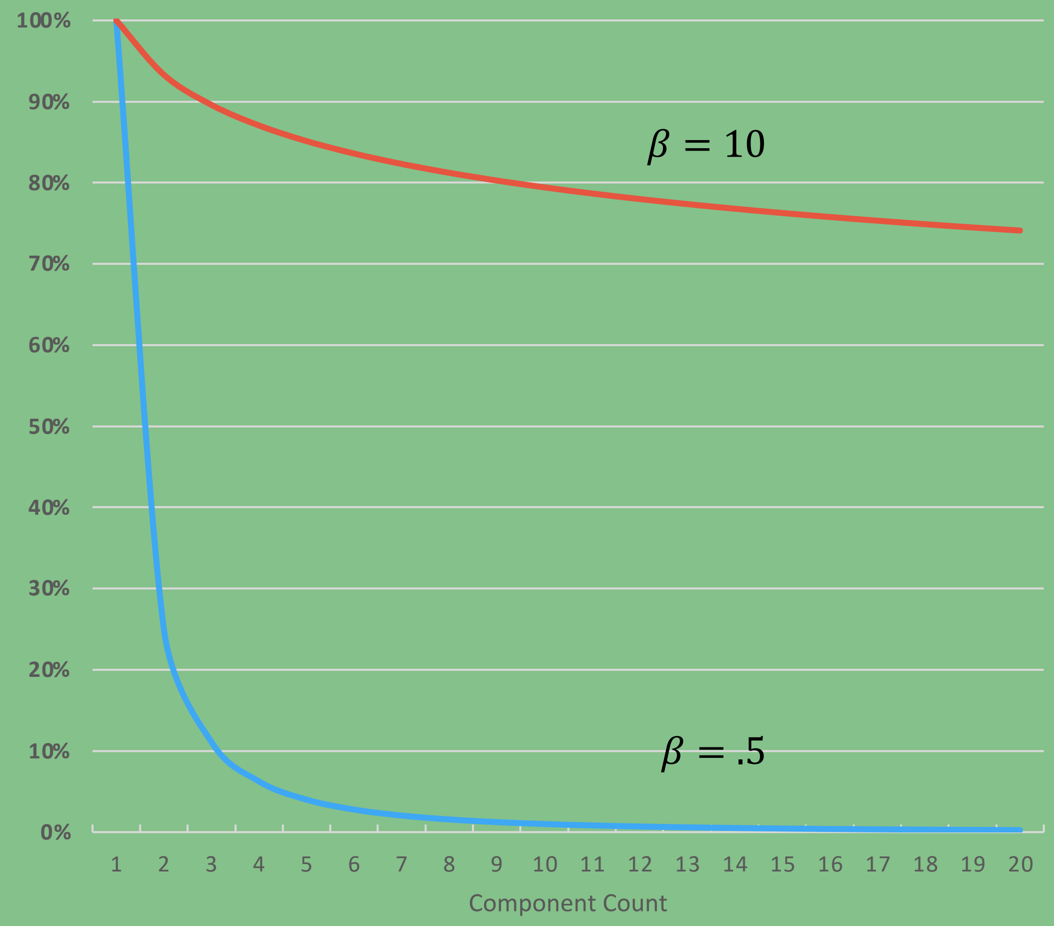
AFFECTED BY DIFFERENTIAL INFLATION, TECHNOLOGY CHANGE, AND RELIABILITY CONSIDERATIONS

Historical Price Price Changes

Conceptual Future Price Changes



Lifespan Ratio X Components to One Component



THANK YOU