Economic Hurdles to Adoption

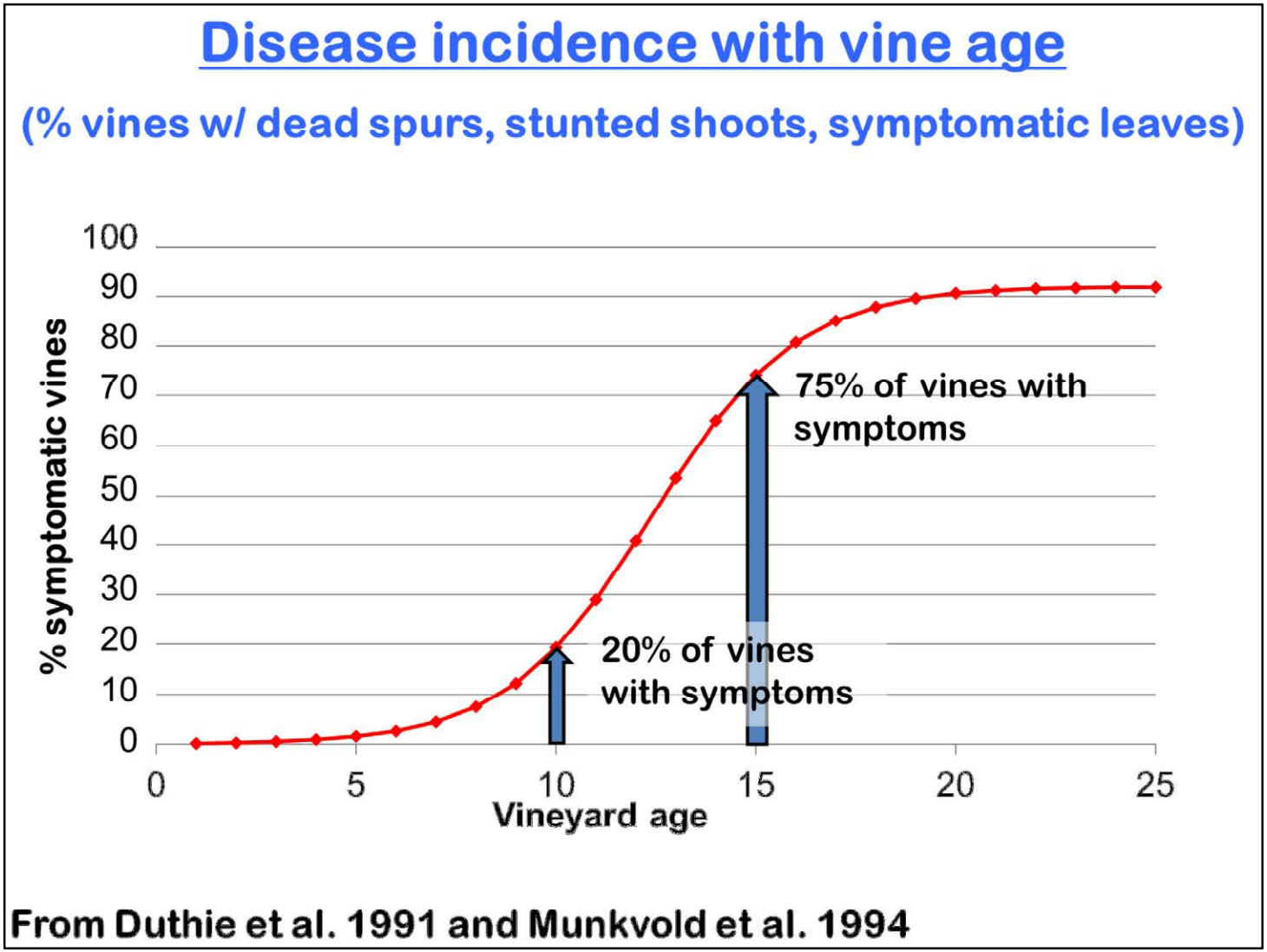
These slides on the economic hurdles to adoption were part of the presentation given to the SCRI Advisory Board on December 3rd, 2014.

Evidence of Biological Efficacy

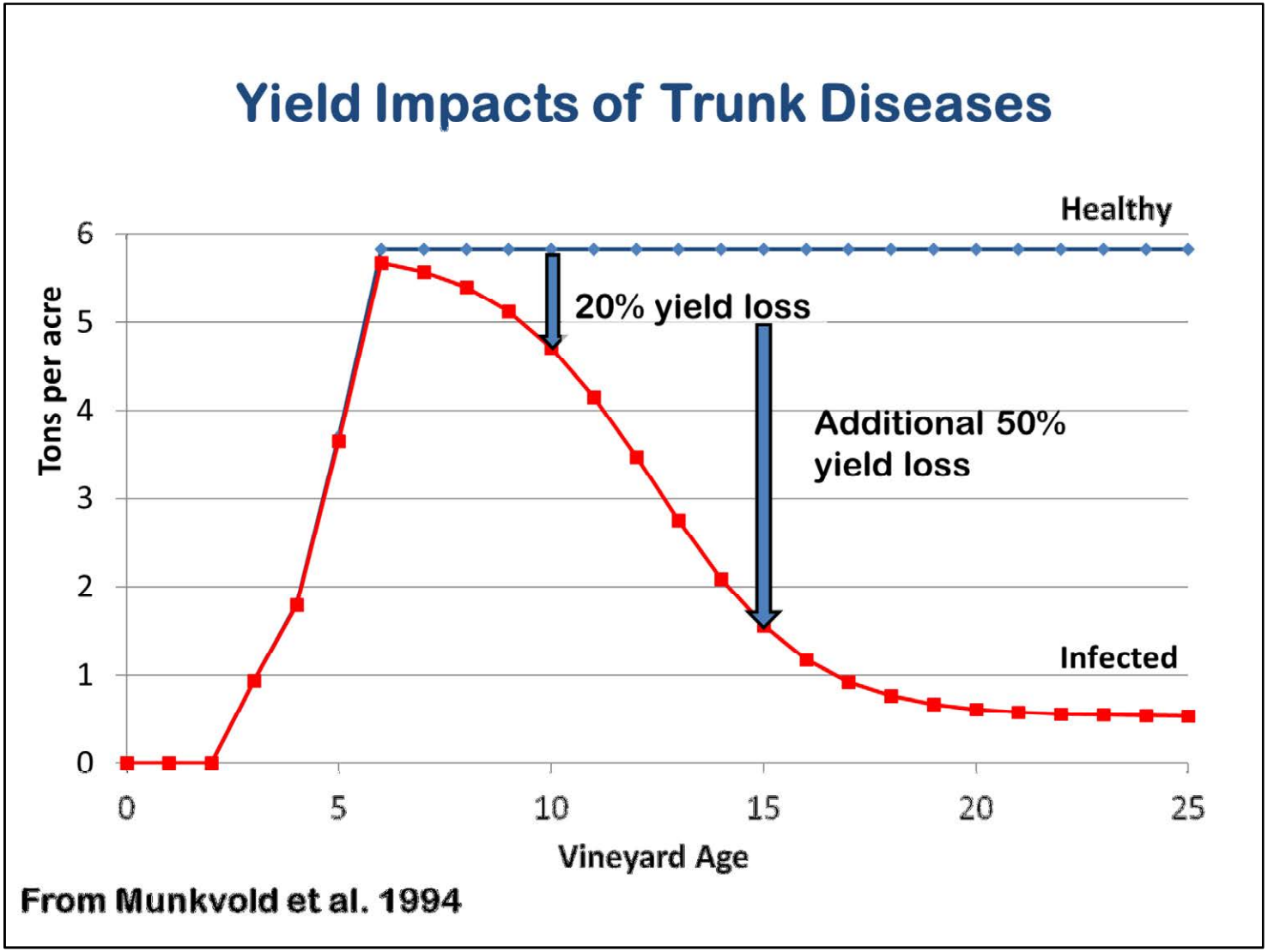
Trunk Disease	Delayed Pruning	Double Pruning	Topsin (handpainted)
Botryosphaeria	58 – 72%	58 – 72%	60 – 80%
Esca	28 – 87%	28 – 87%	52 – 58 %
Eutypa	75 – 97%	75 – 97%	100%

Sources: Amponsah et al. (2012), Larignon & Dubos (2000), Rolshausen et al. (2010), Urbez-Torres & Gubler (2011), Weber et al. (2007).

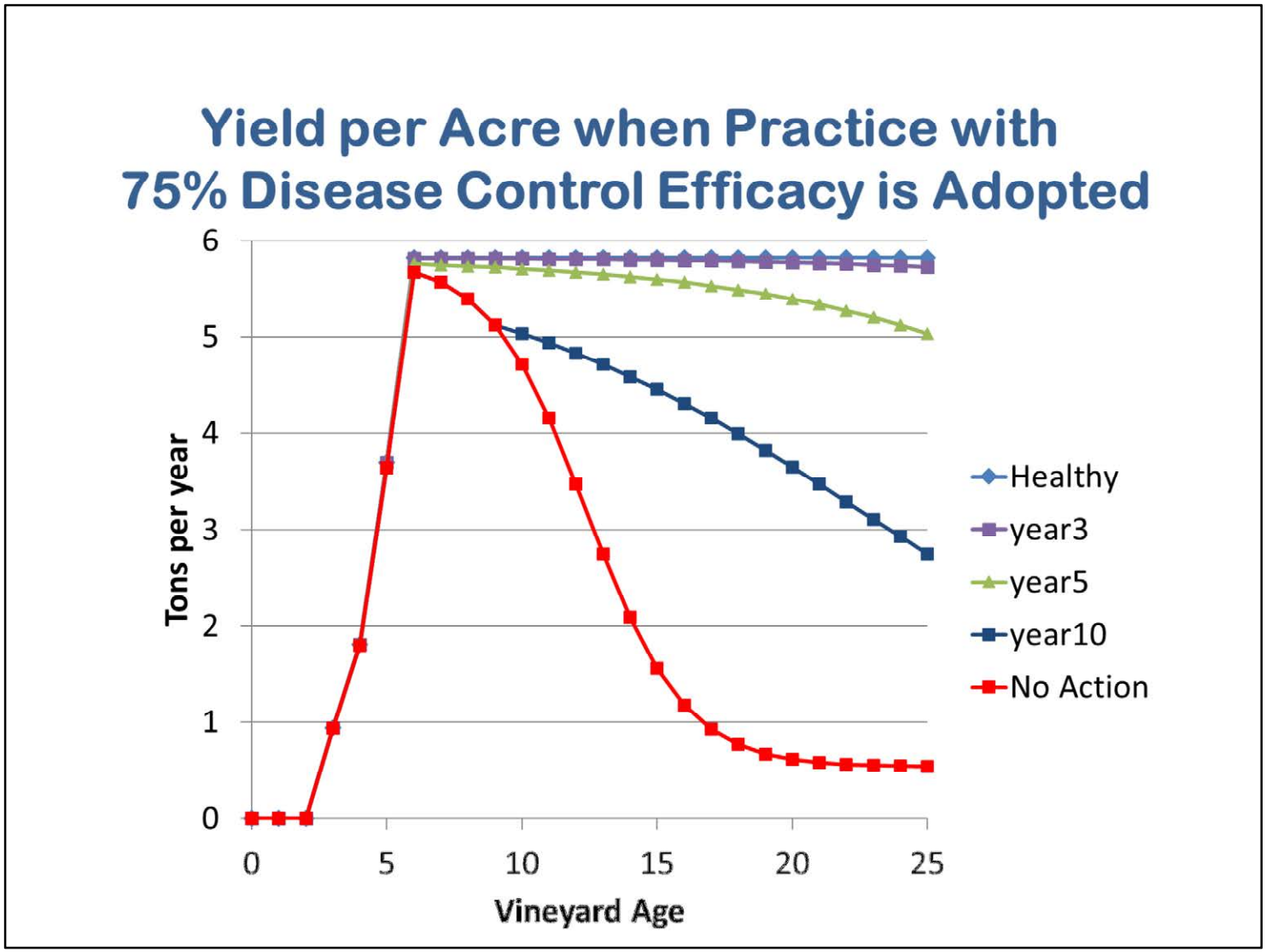
Empirical evidence shows that preventative practices have a wide range of efficacy in pruning wound infections. The table above summarizes what we found in the literature in terms of disease control efficacy (DCE), where DCE measures the percentage of pruning wounds protected by the practice, in field trials. For our simulated economic experiment we consider disease control efficacy rates of 25%, 50%, and 75% to span the range of efficacy values against the trunk diseases listed above.



Here we see from the scientific literature how trunk diseases might grow throughout a vineyard over the vineyard's lifespan. We can see that disease incidence is very low during the first five years, but then accelerates at a rapid pace starting in year 8, reaching a level of 20% by year 10. By year 15, 75% of vines have been shown to exhibit some symptom of a trunk disease, in vineyards where no action is taken to manage trunk diseases.



The effect increasing disease incidence has on yield are seen above. In the first few years, when disease incidence is low, the difference in yield per acre between an infected and healthy vineyard is negligible. As the vineyard and infection age the yield per acre difference grows and does so quickly. From ages 5 to 10 years, yield losses start at nearly nothing and then grows to 20%. Between years 10 and 15, the vineyard losses an additional 50%. If preventative practices can decrease disease incidence, and thus minimize the yield impacts (and in a cost-effective manner), we make the assumption that they will increase the profitable lifespan of a typical California vineyard.



The figure above shows the yield per acre for a hypothetically healthy vineyard, an infected vineyard in which no action is taken to manage trunk diseases, and whena practice with a level of 75% disease control efficacy (i.e., it protects 75% of pruning wounds) is adopted in a vineyard of ages 3, 5, or 10. We can see less yield loss the earlier the practice is adopted. Indeed, if adopted in year 3, the vineyard has annual yields similar to that of a healthy vineyard.

From a disease incidence standpoint, adopting preventative practices seems to make sense. However, there is a cost associated with each preventative practice. Is it therefore cost effective to adopt and to adopt early, given different efficacy rates and costs for these practices?

Annual Net Returns Relative to No Action (per acre, averaged over 25 years)

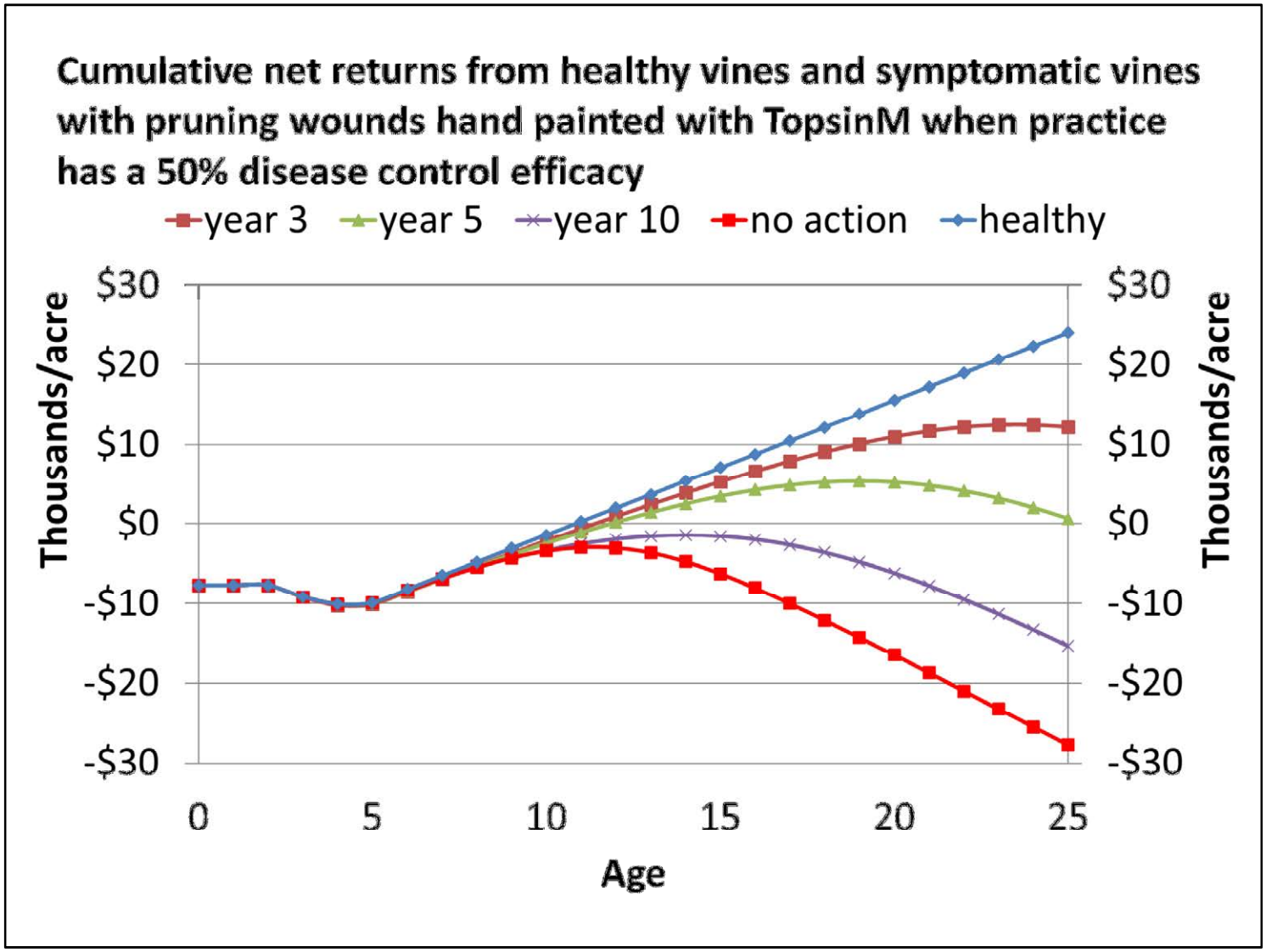
	Delayed Pruning	TopsinM, painted by hand	Double Pruning
Practice Cost per acre	$0	$72	$359
year=3,25% Efficacy	$651	$584	$321
year=5,25% Efficacy	$440	$379	$139
year=10,25% Efficacy	$191	$145	-$38
year=3, 50% Efficacy	$1,664	$1,597	$1,334
year=5, 50% Efficacy	$1,197	$1,136	$896
year=10, 50% Efficacy	$543	$497	$313
year=3, 75% Efficacy	$2,052	$1,986	$1,722
year=5, 75% Efficacy	$1,887	$1,826	$1,586
year=10, 75% Efficacy	$844	$797	$614

Here we see the preliminary results of our economic model for a Central Coast vineyard. In the top row, the blue values for the three practices are their costs relative to standard pruning (i.e., pruning in December, when disease risk is high). For example, the cost of delayed pruning is shown as **$0** because the labor/material costs for delayed pruning are identical to those of standard pruning—only difference is the timing.

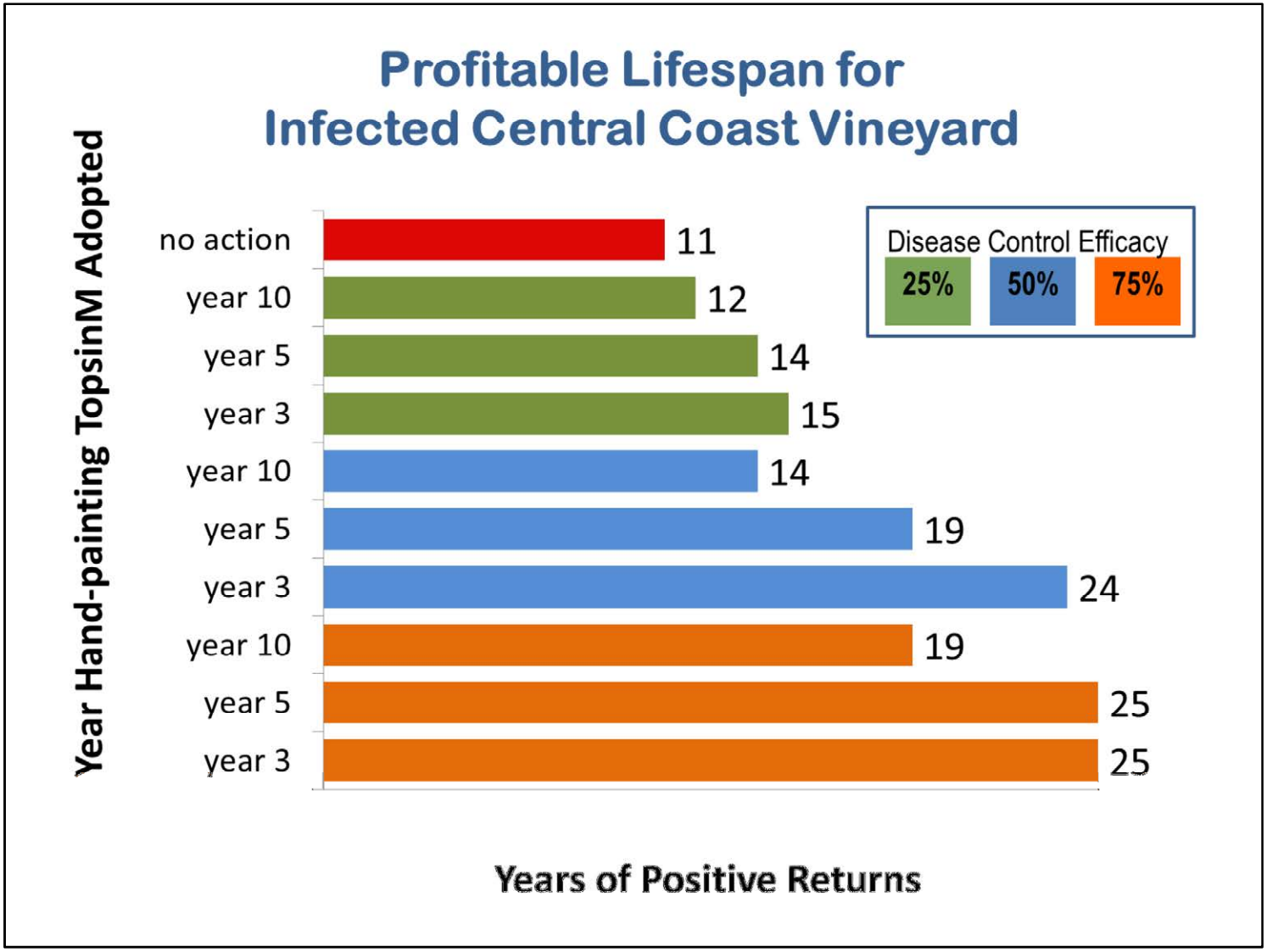
Values in the rows below the practice costs are the net returns (revenues minus costs) for preventing trunk diseases, compared to taking no action. Values that represent cost-effective scenarios are shown in **black**. The values shown in **red** represent bad scenarios—the vineyard loses money over its 25-year lifespan. Positive red values are still better than taking no action; you lose less money. The negative red value (**-$38**) represents the only scenario that is more costly than taking no action. Interpretation of the -$38 is as follows: In the Central Coast, our model suggests that adopting double pruning in year 10 is more costly than taking no action. This is under the assumption that double pruning is only 25% effective, for example at the low range of efficacy against the Esca pathogens.

In the Central Coast, the good scenarios tend towards adopting in years 3 or 5, and at levels of disease control efficacy of 50 and 75%.

*Similar results were seen in the other regions except for the representative vineyards in our Napa-Sonoma and Southern San Joaquin regions, which generated positive returns under all adoption scenarios including no action. It appears waiting until year 10 to adopt preventative practices is too late.

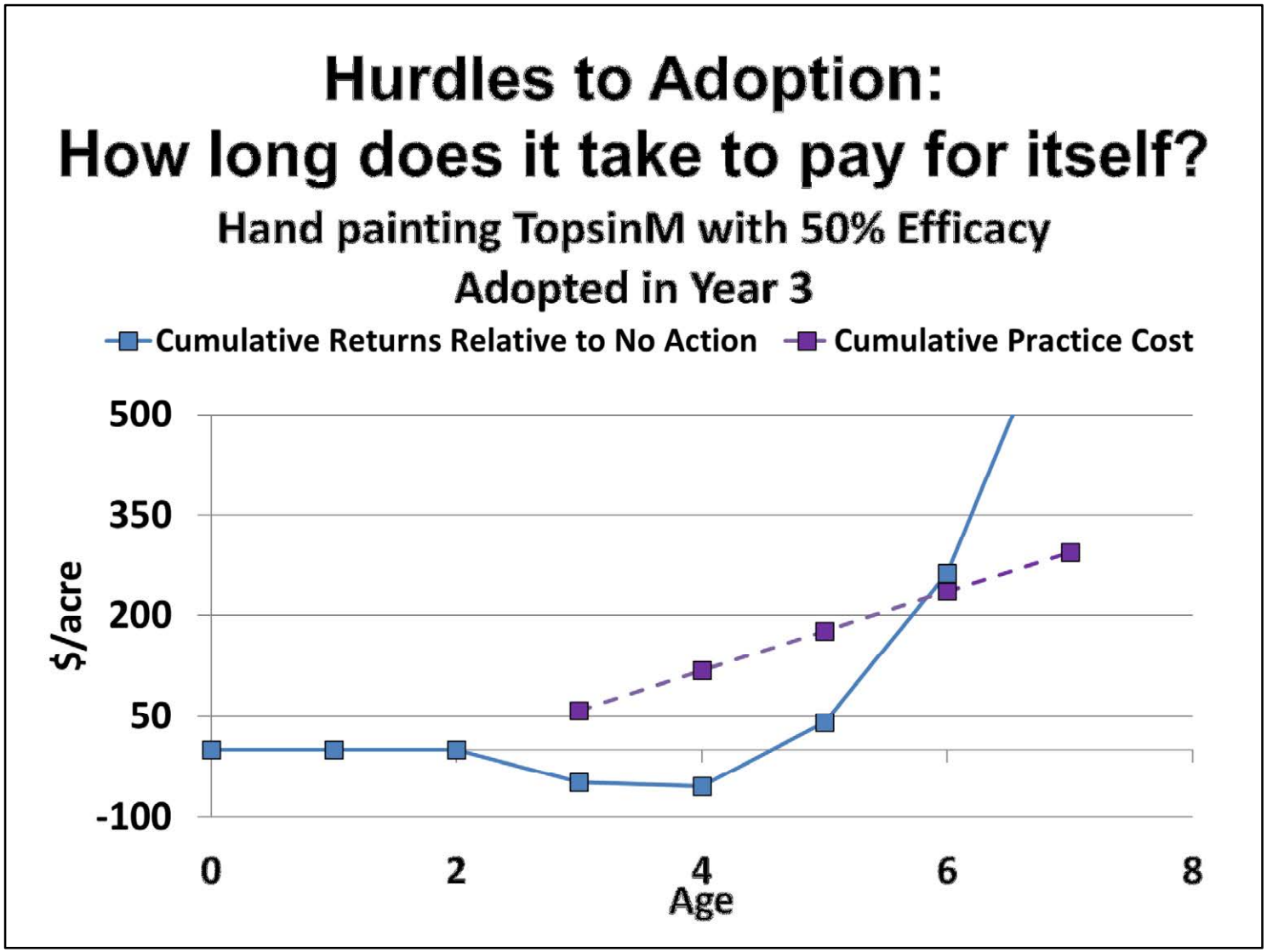


An examination of the effect of trunk diseases on cumulative net returns over a vineyard's lifespan shows that adopting early gives growers the best chance of generating positive net returns over that time. Although the figure above is for one particular efficacy rate and practice cost, this result is seen with other scenarios as well. We also do not see much divergence between the scenarios until the vineyard reaches its 10th year, regardless of the disease control efficacy given the slow initial growth of the diseases. Unfortunately, as noted above, waiting until year 10 to adopt is often too late. In the later years, we see annual net returns are negative by the negative slope, suggesting vineyards infected with trunk diseases where practices are adopted late or not at all may be removed quite a few years earlier than those where practices are adopted early.

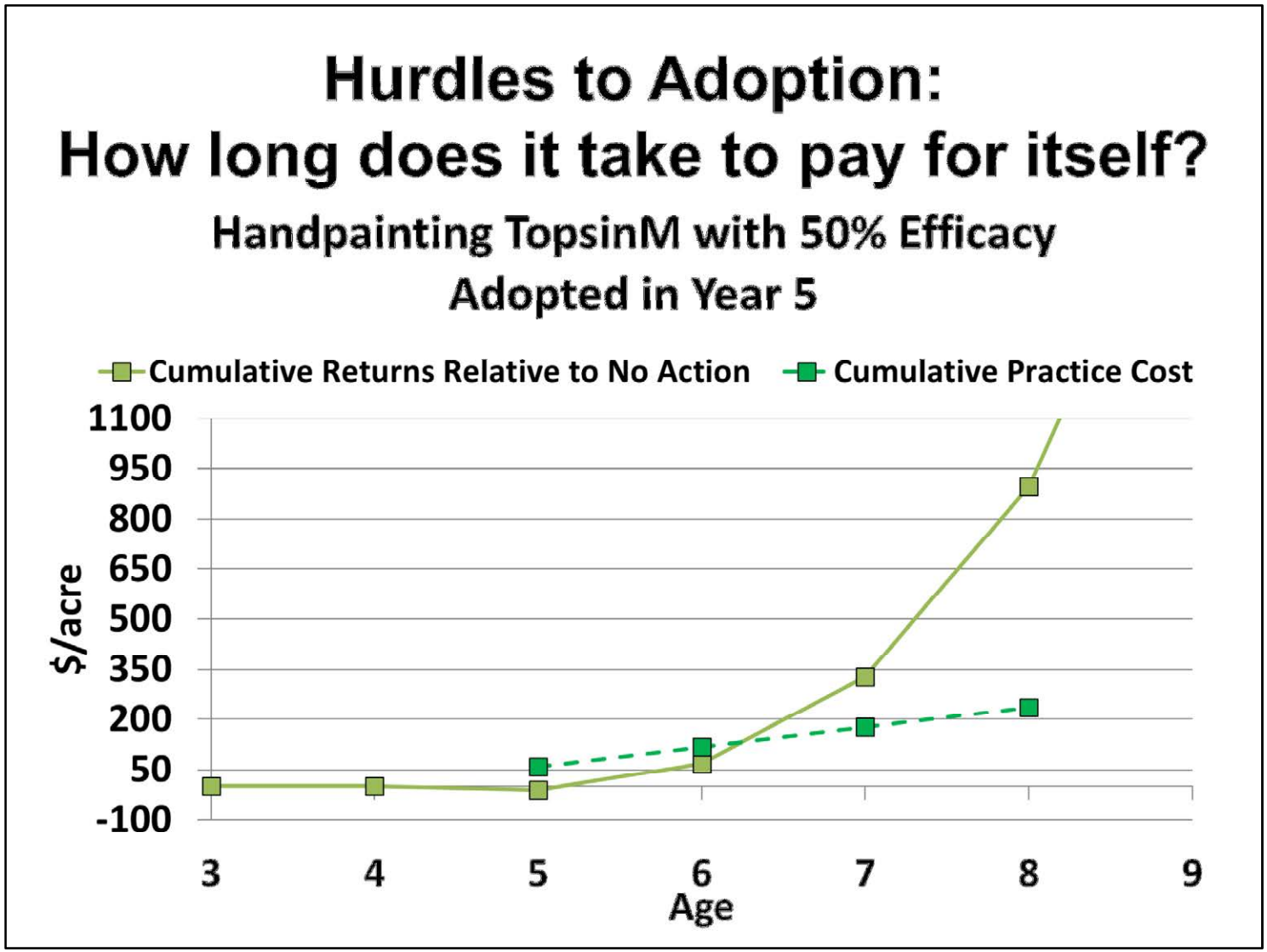


These results show the last year annual net returns are positive for a mature vineyard. Although these lifespans are for one region and one practice, the pattern we see here is seen in the other scenarios as well. The sooner adoption occurs, the longer the vineyard will provide positive annual net returns. Why then are growers not adopting these practice early or at all?

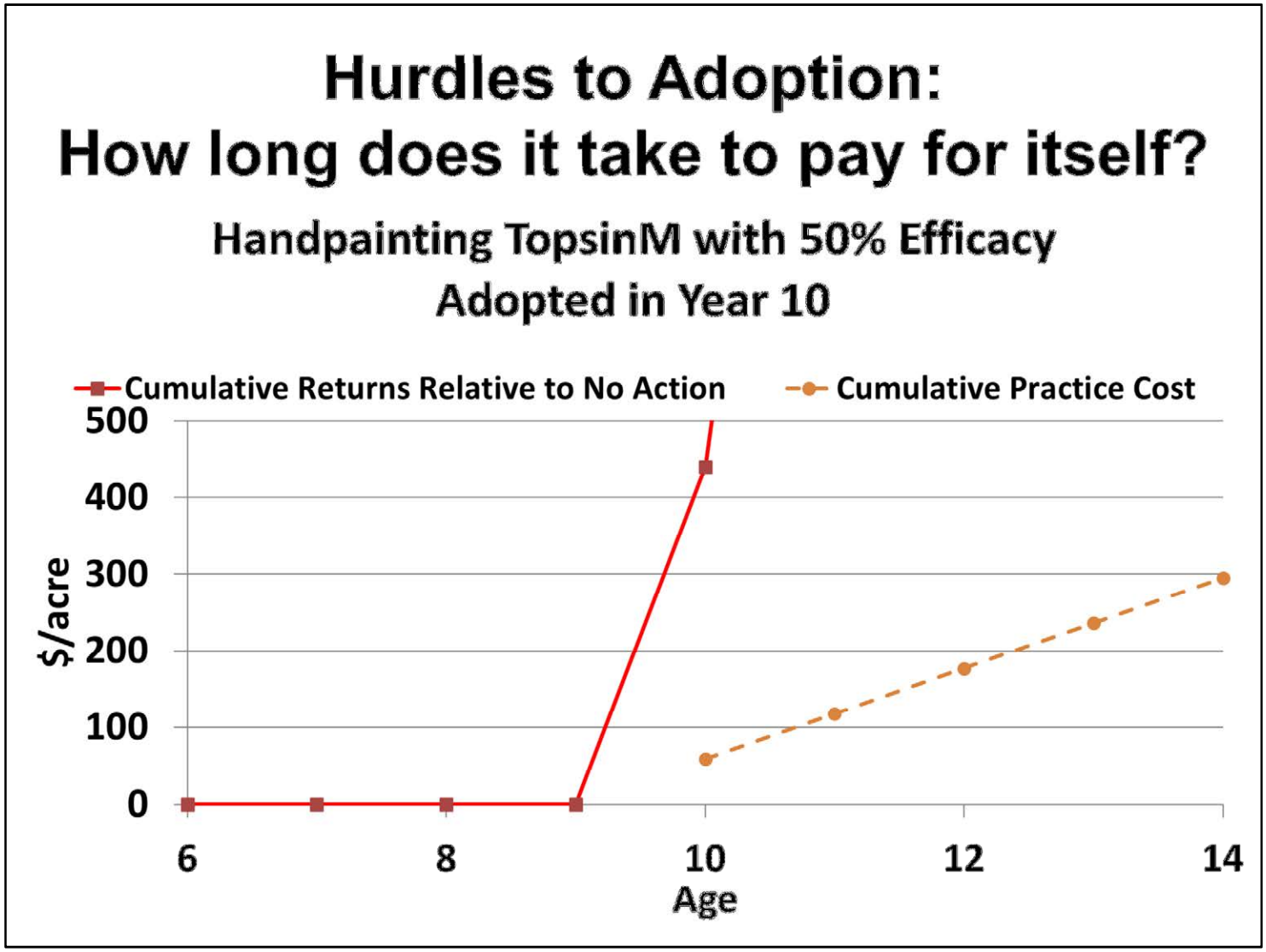
Hurdles to Adoption: How long does it take to pay for itself?



Here's one explanation for why growers are not adopting preventative practices early or at all: it takes too long to pay for itself. Recall trunk diseases take a relatively long time (Years 8 to 10 are when they tend to become noticeable) to build up a high enough incidence that they start to affect yields. Adopting practices that are costly when the difference in yield is negligible (i.e., before year 8) puts the grower at a disadvantage. In this slide we see that it takes up to 4 growing seasons for the practice adopted in year 3 to generate cumulative returns greater than those from doing nothing and enough to cover the cumulative practice cost.



Still at year 5, the disease incidence is too low (and yield losses are too negligible) for the preventative practices to pay for themselves. It could take up to 3 years in most scenarios.



It is not until year 10, when 20% of the vineyard shows some symptom of a trunk disease (and yields are reduced by 20%) that adoption of preventative practices pays for itself in the year it is adopted. Unfortunately, as made clear earlier, waiting until year 10 is often too late in the disease cycle, and net returns in subsequent years will fade quickly.

Next steps

Grower Questionnaires

numbers are clear, we want to be certain

District-level Consequences

capture district and region uniqueness

Extension Tool Development

inform growers using extension outlets, workshops, web-based resources

Market-level Analysis

evaluate widespread early adoption
estimate change in yields, lifespans, prices
model changes in planting/removal decisions

In the not so distant future we will survey growers about the costs of preventative practices and the effect trunk diseases have on yields and vineyard lifespans. These responses will inform a more district-level analysis which will capture the uniqueness of the different crush districts in California. With these insights we will develop extension tools that will be disseminated through extension outlets, in-person workshops and presentations, and web-based resources. Simultaneously, concern about the market effect of widespread adoption is also of interest as wide-spread adoption will affect yields, lifespans, and ultimately prices for winegrapes. This in turn implies that planting and removal decision need to be evaluated to understand the broader economic benefits to growers implied by changing market conditions.