

Sampling Methods for the Grapevine Regulations Working Group

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General comments on sampling

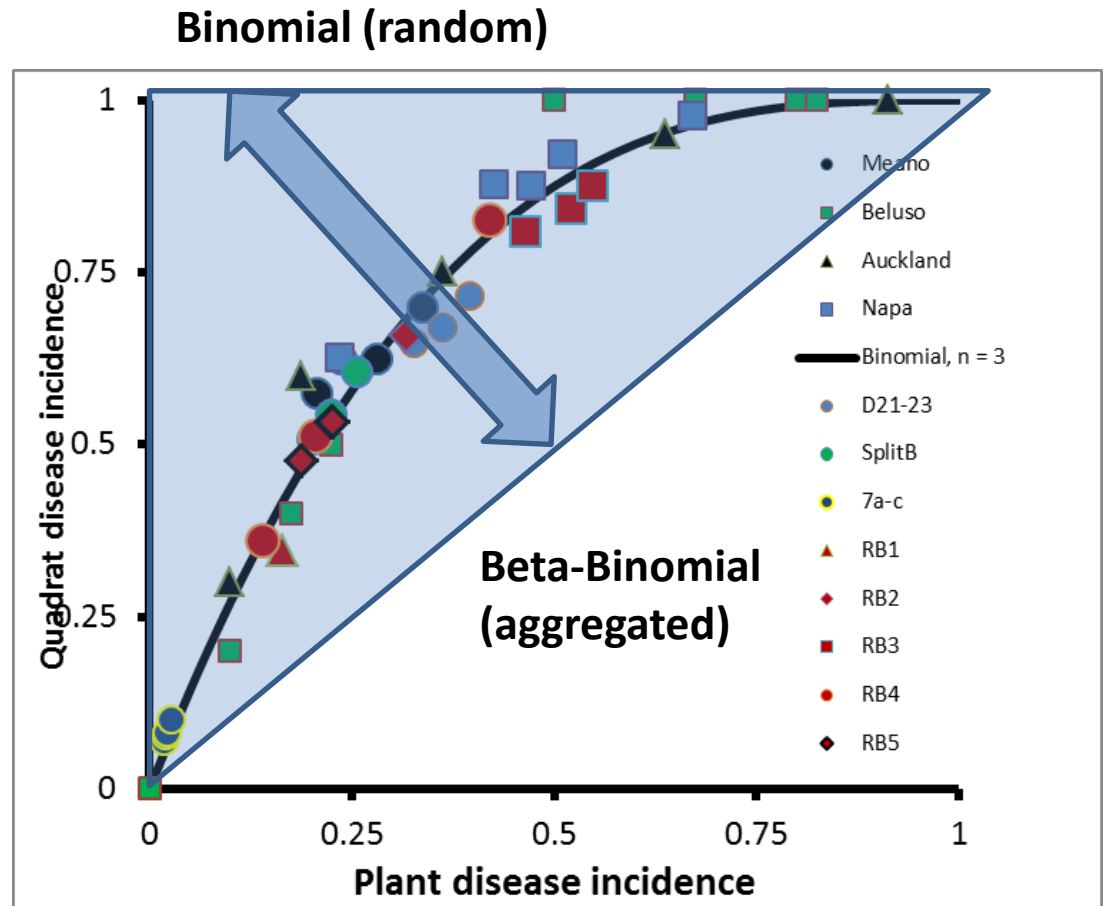
- It **does not** give definitive answers
 - Statistically designed sampling plans have known long-run performance but can under- or over- estimate disease in any specific case
- It **does not** always (ever?) reduce uncertainty
- It will almost always be constrained by money and/or time
- It should be done often and as early as possible in the propagation chain
- Do not overlook the value of visual inspection

Objectives

- Discuss diseases of interest
- Discuss current increase blocks
- Discuss sampling methods and theory
- Discuss the definition of certification

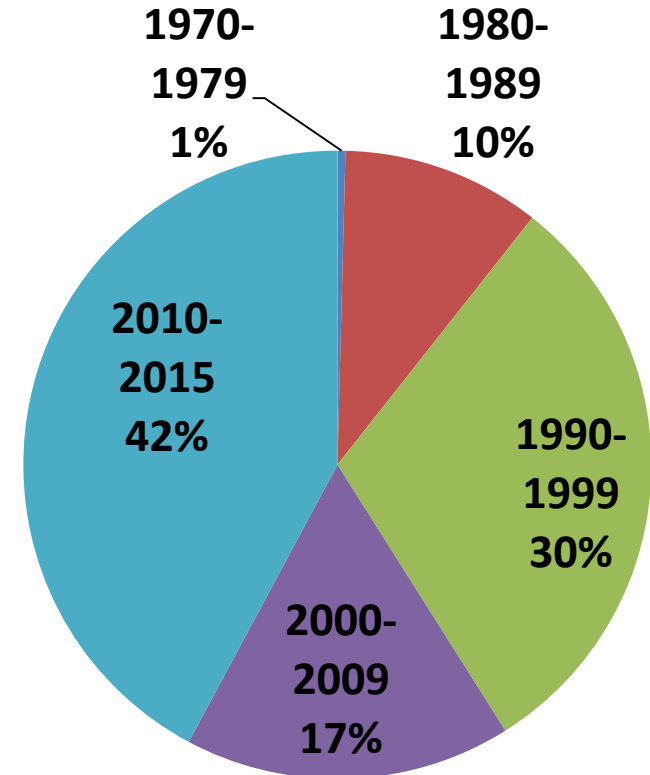
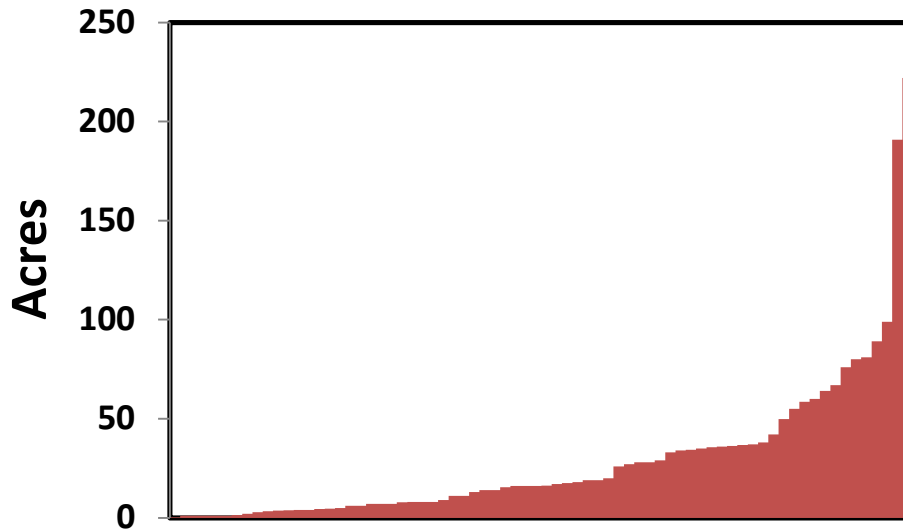
Leafroll and Red Blotch

Aggregation appears to be similar for both viruses



Current Increase Blocks

Sizes of Increase Blocks

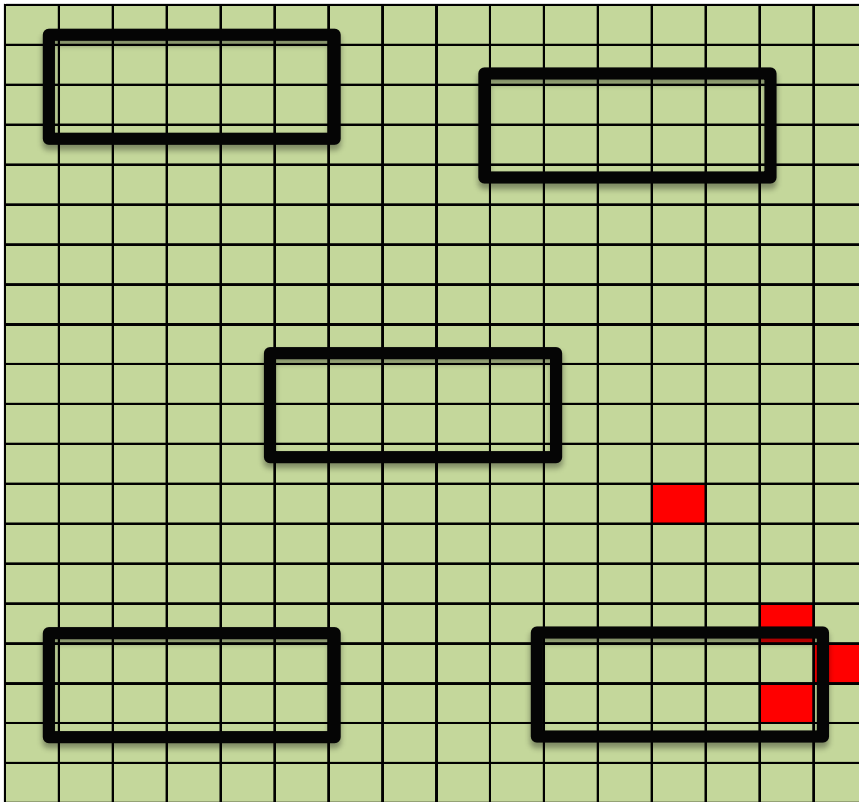


Proportion of acreage by the year established

Sampling Strategies

p = estimated disease incidence
 N = number of groupings
 n = number of plants in a grouping
 θ = aggregation parameter
(adjustment for patchiness)

Example



vines = 320

infected = 4

DI = 0.0125

$p = 0.01$ (assumed)

$N = 5$

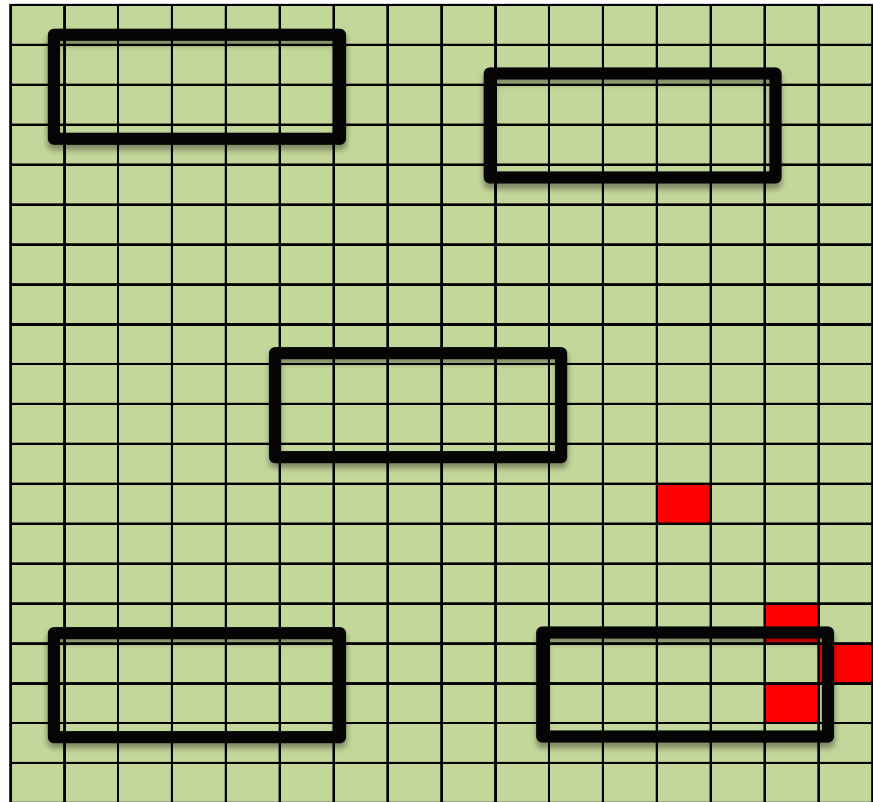
$n = 10$

$\theta = \text{patchiness}$

Why group sampling?

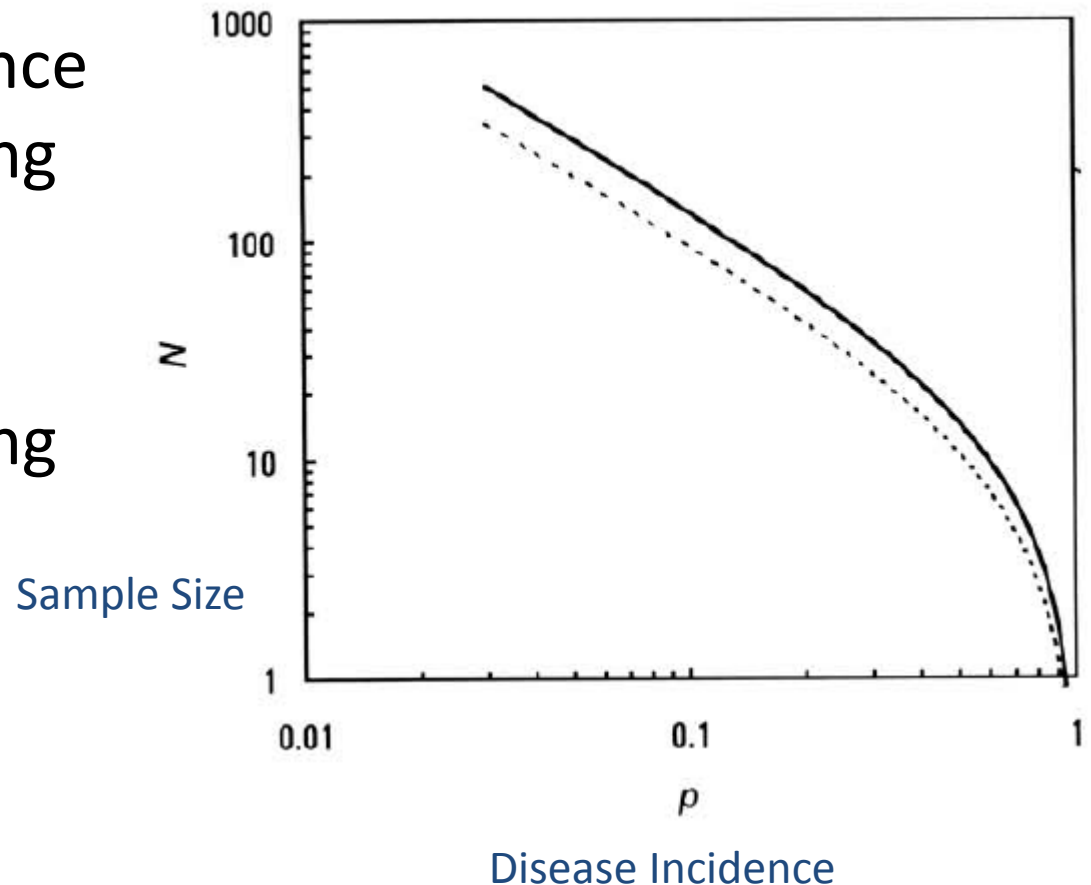
*Allows for an assessment of variance

*Future adjustments and assumptions can be made from previous data



General comments on sampling

- As disease incidence increases, sampling size decreases
- As patchiness increases, sampling size increases



Estimating Mean Incidence as 1%

$$N = (1 - p)/npCV^2$$

Random/binomial model

$$N = ((1 - p) * deff)/npCV^2$$

Aggregated/beta-binomial model

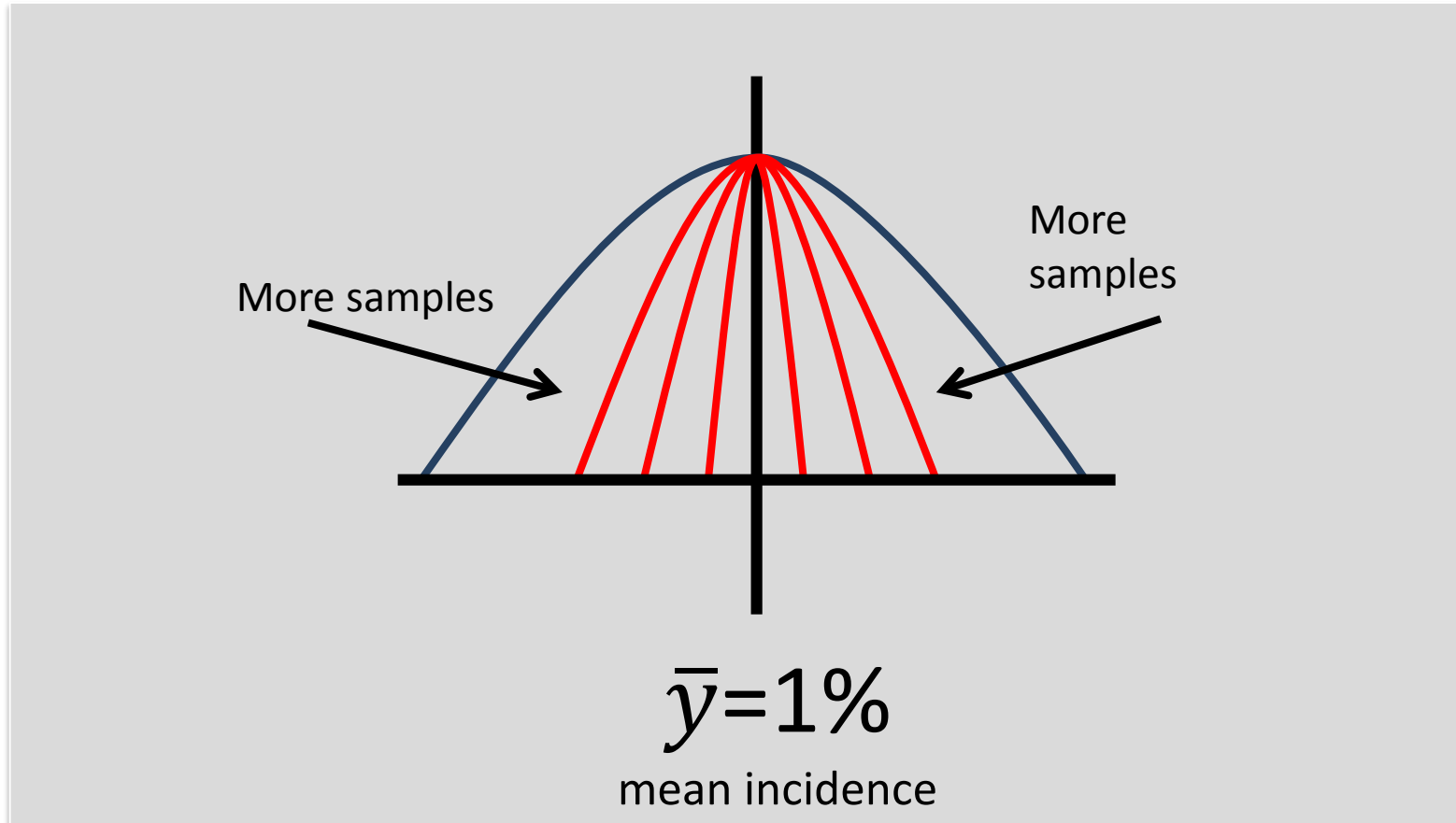


$$deff = (1 + \rho) * (n - 1)$$

$$\rho = \theta / (\theta + 1)$$

$$\theta = \text{aggregation/patchiness}$$

How this model works



Estimating Mean Incidence

$$N = (1 - p) / npCV^2$$

$$p = 0.01$$
$$n = 10$$

	<i>CV</i>	<i>N</i>	<i>n</i>	ELISA (\$6)	PCR (\$20)
90%	0.2	247.5	10	\$14,850.00	\$49,500.00
95%	0.1	990	10	\$59,400.00	\$198,000.00

*Finite population correction: $N(1 - f)$
When N is greater than 10% of the population

Estimating Disease Incidence

Assume:

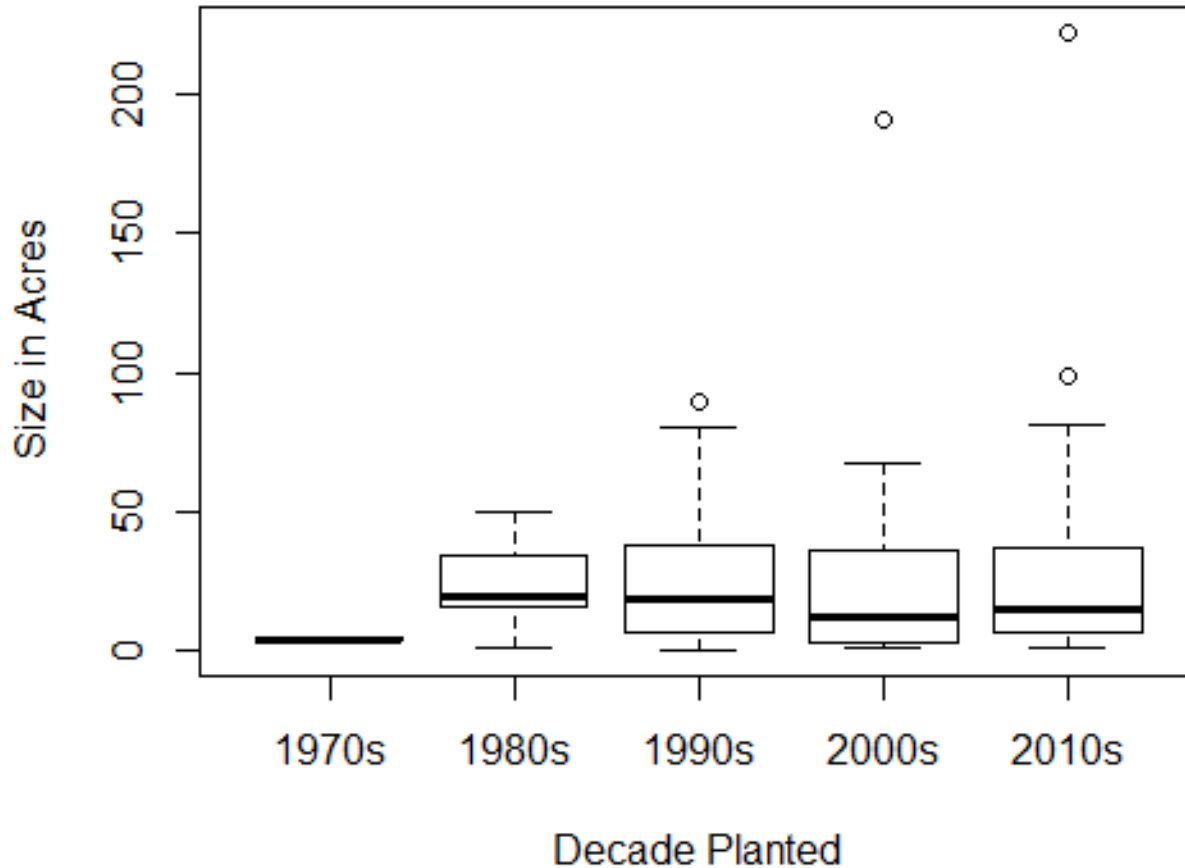
1 acre = 1000 vines

Average size is about 25 to 35 acres, or 25,000 to 35,000 vines

2500-3500 vines
 $N=247.5$ is appropriate

If half the blocks fit this size, cost = \$1.75 million on testing alone, on a 3 to 5 year rotation

Increase Blocks



If you don't find it, is it really not there?

$$\Pr(X = 0) = (1 + n\theta)^{-N\frac{p}{\theta}}$$

Probability of not detecting disease if true vine incidence is p , group size is n and N groups of tests are made

$$p = -\theta \cdot \log(P)/N \cdot \log(1 + n\theta)$$

Maximum true vine disease incidence that could result in zero positives, given group size n , N groups, with probability P .

$$N = -\theta \cdot \log(P)/p \cdot \log(1 + n\theta)$$

Sample size required to generate zero positives, given group size n and true disease incidence p , with probability P . Larger samples will give one or more positives

Detecting Disease Incidence >1%

$$N = -\theta \cdot \log(P)/p \cdot \log(1 + n\theta)$$

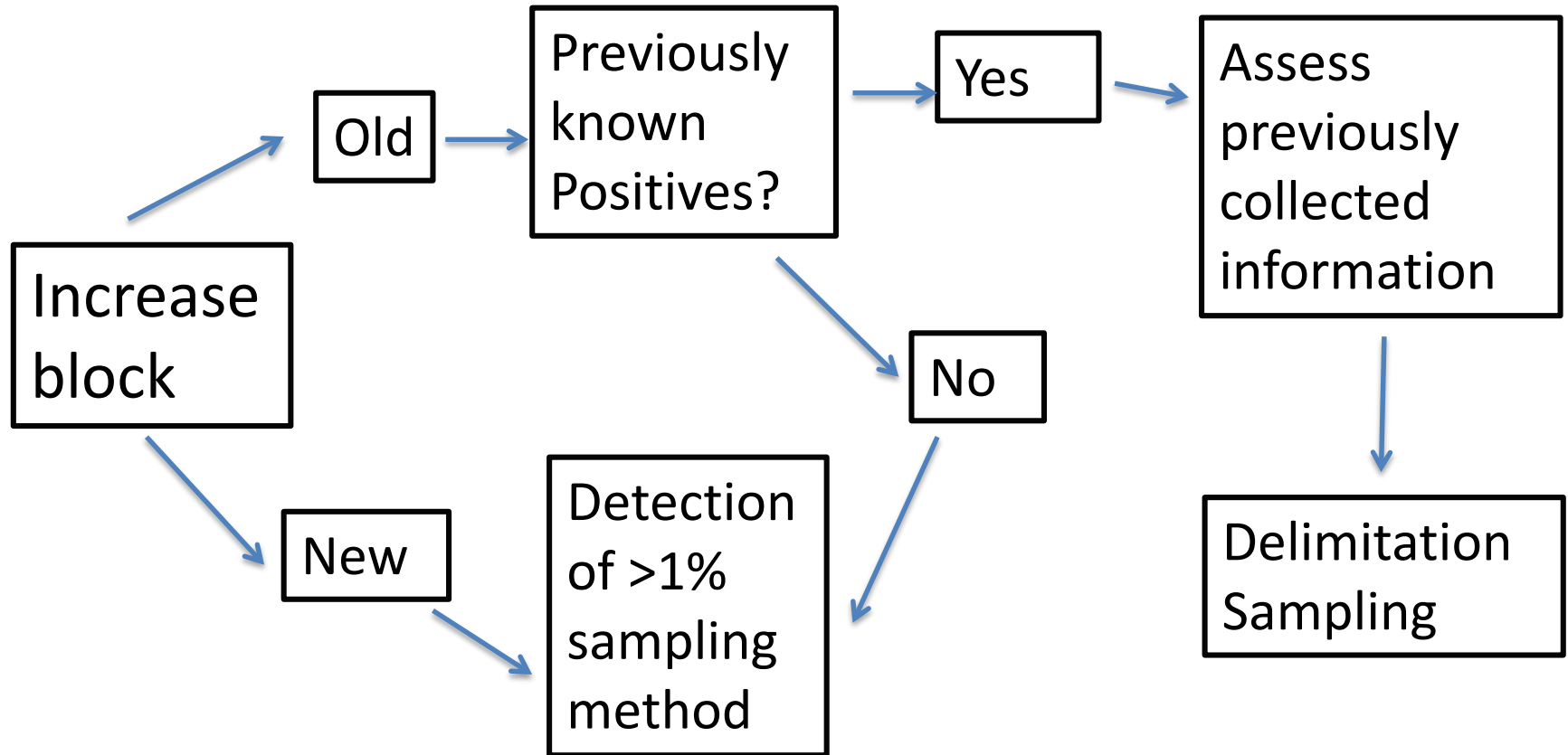
$$p = 0.01$$

$$n = 10$$

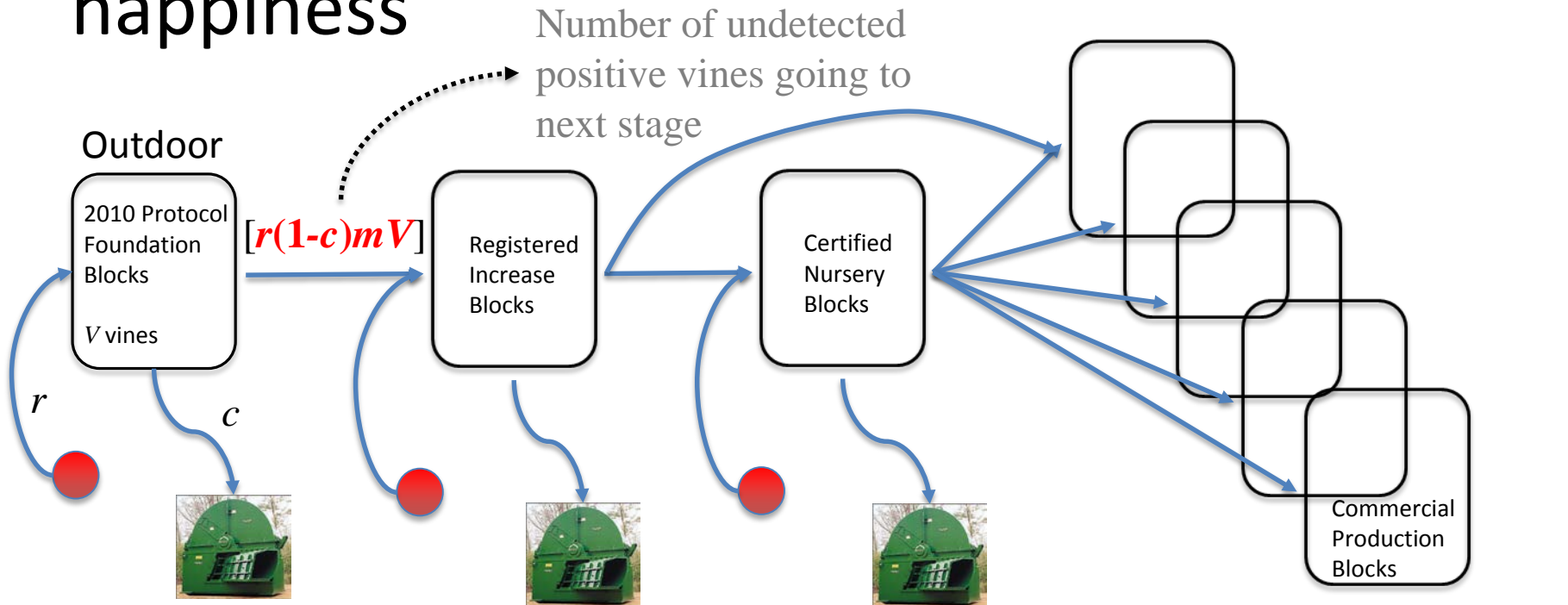
$$\theta = 0.0343$$

	P	N	n	ELISA (\$6)	PCR (\$20)
80%	0.2	18.7	10	\$1,122.00	\$3,740.00
90%	0.1	26.7	10	\$1,602.00	\$5,340.00
95%	0.05	34.8	10	\$2,088.00	\$6,960.00
99%	0.01	53.6	10	\$3,216.00	\$10,720.00

Sampling Flow Chart



The certification discussion and the future: realistic expectations are the key to happiness



$$c = d \times tpp$$

d = probability of detection (sampling) = $f(n, N, p, \theta)$

tpp = diagnostic true positive proportion

r : background contamination rate

Does Virus Tested = Virus Free?

Does Certified = Clean?

- Science isn't perfect, neither are we
- There is no unicorn certification program, error is everywhere



Defining “Certification”

4 things to consider:

1. Sampling methods
(discussing today)
2. Background risks
3. Time period between sampling rotations
4. Designing the sampling plan is only the beginning, this is a work in progress

Producers/growers need to understand this



*Thank you:
AVF, CGRIC, IAB, CDFA*

Questions?