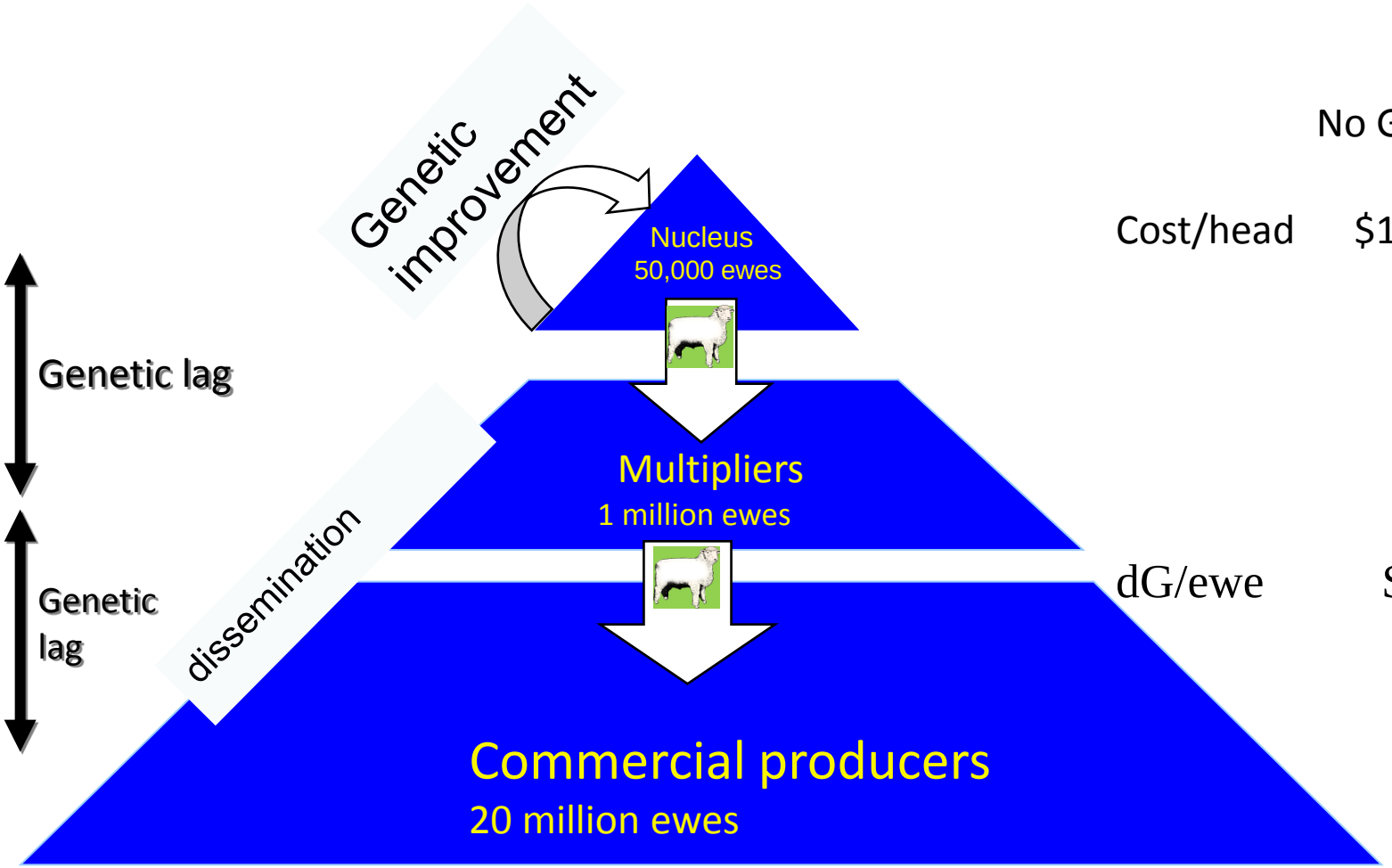
University of New England

Optimizing Breeding Programs

COST-BENEFIT of genomics

Cost - Benefit of breeding programs



	No GS	GS
Cost/head	$10	$60
dG/ewe	$2	$2.2

Cost-Benefit industry wide

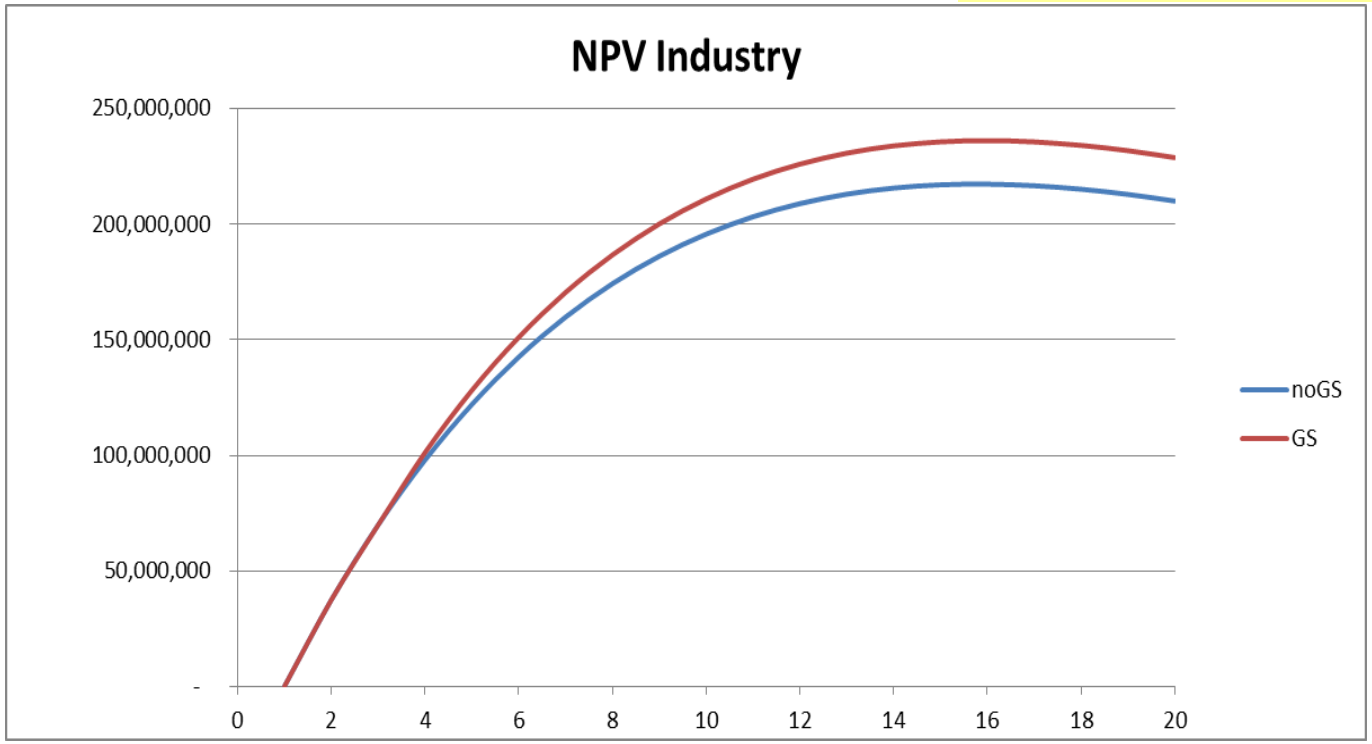
3 tier benefit

Per annum added

This does not accumulate ←

This accumulates ←

	No GS	GS
Cost	$0.5 M	$ 1.65 M
dG Return	$40 M	$ 44 M
Cum NPV	$2.45 b	$2.65 b



Note the much higher cost and lower RTI ratio!

50k Nuc ewes
20M Comm

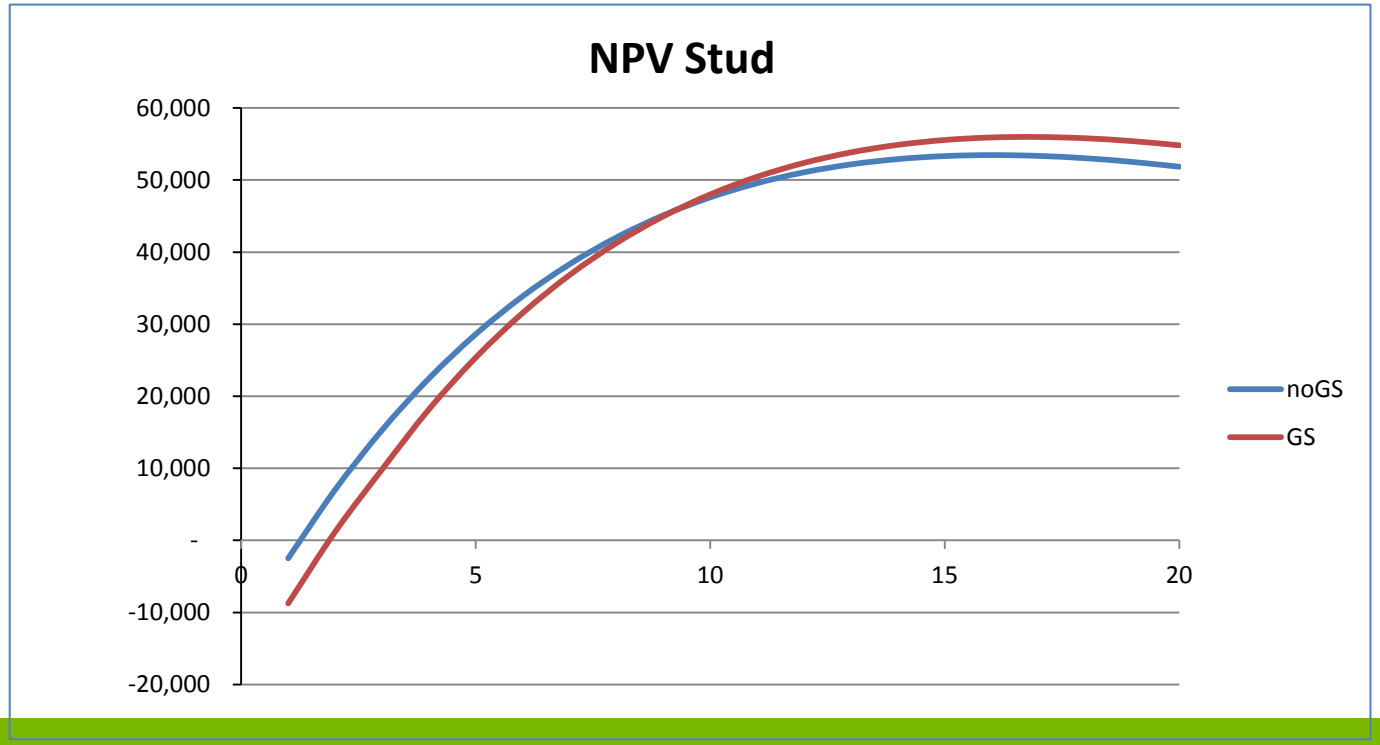
Cost-Benefit Stud + Direct clients

2 tier benefit

Per annum added

50-50 split of benefit between stud and comm

	No GS	GS
Cost	$ 5 k	$17.5 k
Returns dG	$20 k	$ 22 k
Cum NPV	$807 k	$859 k



500 Nuc ewes
10k Comm

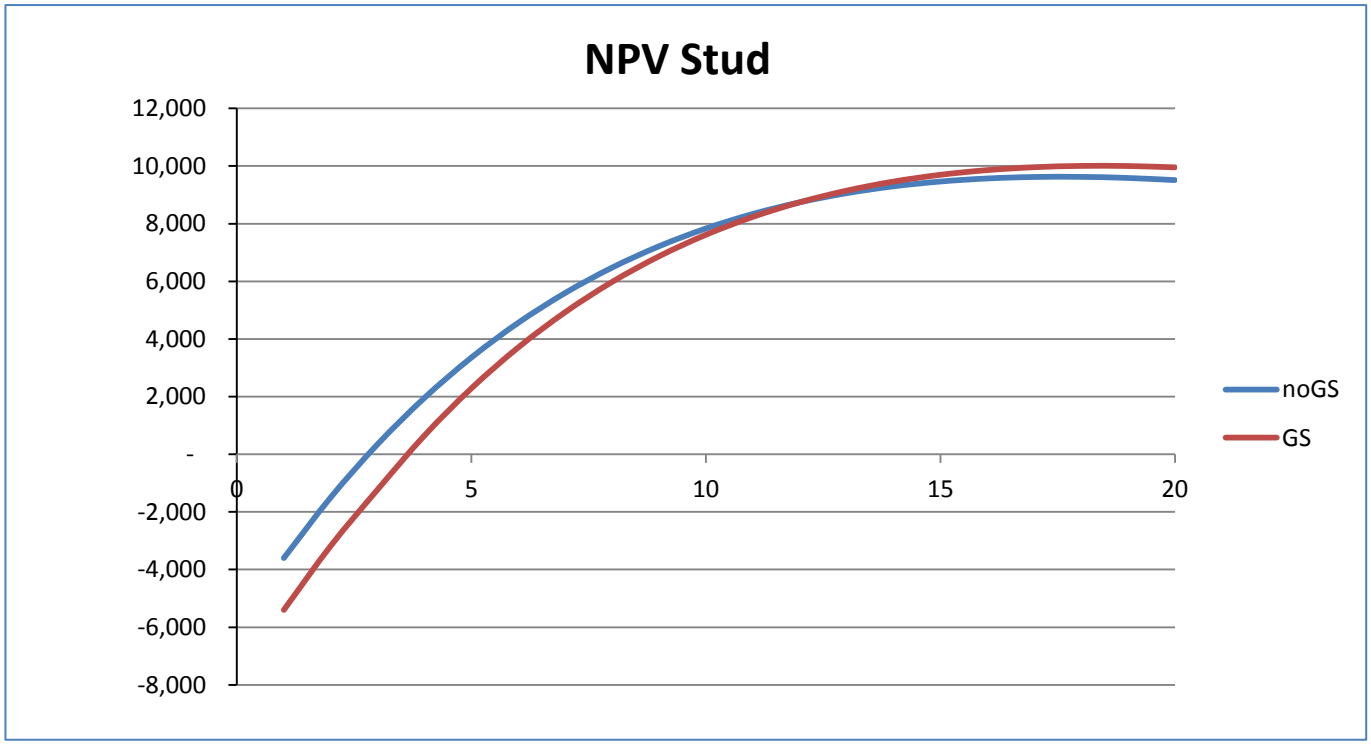
Cost-Benefit Stud + Direct clients

2 tier benefit

Per annum added

90 -10 split of benefit between stud and comm

	No GS	GS
Cost	$ 5 k	$17.5 k
Returns dG	$20 k	$ 22 k
Cum NPV	$125 k	$117 k



500 Nuc ewes
10k Comm

Value of selecting Stud Rams and Flock Rams

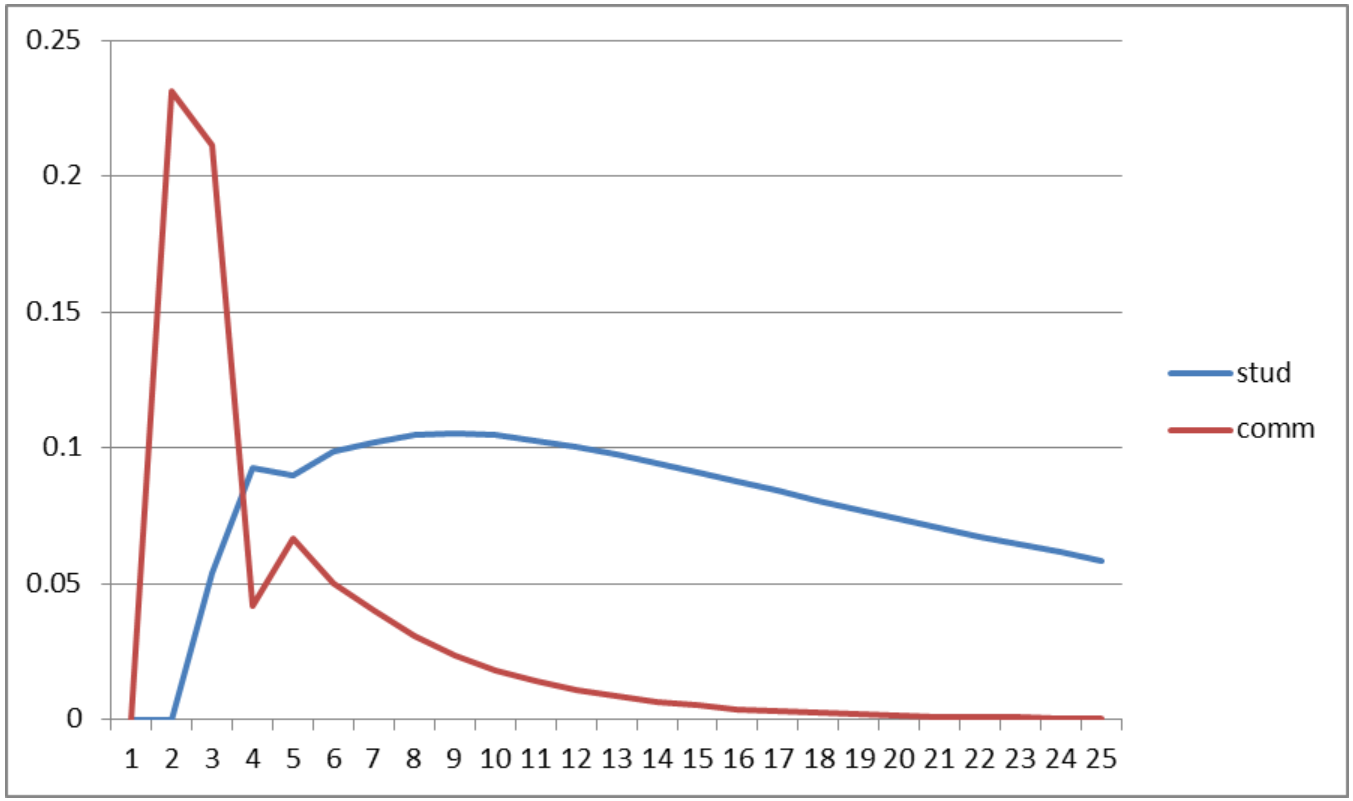
Value of a superior ram

CDE

= Selection Difference * Nr.Progeny * expression per progeny

Flock Ram	+ 1.4	100	0.55	= $ 77
Stud Ram	+ 3.0	400	1.35	= $ 1,620

(allele) frequency of one unit of superiority as expressed in commercial flock



Discount rate	CDE flock rams	CDE stud rams
0	0.99	3.93
0.05	0.78	1.96
0.08	0.68	1.37

Flock structure

Nr Cows Commercial Herd	12,000	
Comm Dams/sire	50	
Comm Sire replacem. rate	0.33333	
Comm Weaning rate	1	
Nr new rams needed for comm herd/yr	80	
Nr lifetime Progeny per commercial sire		150

100 prog/flock ram

Prop. Stud.Males sold as breeding bull	20%	
Stud weaning rate	1	
Stud dams/sire	40	
Nr stud breeding cows	800	
Nr. Of stud sires	20	
Nr of comm bulls sold per year	80	
Proportion of males DNA tested	100%	
Nr. Stud born Male DNA tested/yr	400	
Nr of commercial bulls sold per Stud male	4	
Nr of DNA tested young male per stud bull	20	
Nr of commercial progeny receiving genes from a stud male		600

400 prog/stud ram

Some *real data*

Commerical Flock		Nr Sheep Commercial Flock	34,280	
		Comm Dams/sire	40	
		Comm Sire replacem. rate	0.33333	
		Comm Weaning rate	1.1	
	Nr new rams needed for comm flock/yr		286	
	Nr lifetime Progeny per commercial sire			132

Stud Flock	Prop. Stud.Males sold as breeding ram		40%	
		Stud weaning rate	1.28	
		Stud dams/sire	20	
		Nr stud breeding ewes	1116	
		Nr. Of stud sires	56	
		Nr of flock rams sold per year	286	
	Nr of commercial rams sold per Stud male		5.12	
Nr of commercial progeny receiving genes from a stud male				676

Value of selecting Stud Rams and Flock Rams

Value of a superior ram = Selection Difference * Nr.Progeny * CDE

- Selection differential within the cohort: "The result of one round of selection"

Breeding performance						
			SD of breeding Objective	10		
			Male Selection intensity	2		
			Female Selection intensity	0.5		
			Male Selection accuracy *without* genomics	0.44	increase	
			Male Selection accuracy *with* genomics	0.49	11%	
			Female Selection accuracy	0.4		
			Generation Interval Stud males	2		
			Gneration Interval stud females	4		
	approximaley	1.36	CDE stud sires	1.36		
			CDE flock sires	0.6		
				no GS	GS	
			Sire superiority	8.8	9.8	
			Dam Superiority	2.2	2	increase
			Rate of gain/year	1.8	2.0	7%
			Break Even Cost of DNA test	41		
						value diff
			Value of stud bull	7194	8011	817
			Value of comm bull	261	291	41

Value of selecting Stud Rams and Flock Rams

Value of a superior ram

= Selection Difference * Nr.Progeny * expression per progeny

Stud Ram

	+ 8.8	400	1.36	= $ 7,194
With Genomics	+ 9.8	400	1.36	= $ 8,011

+817

Cost benefit analysis

- Extra benefit per stud sire $817
- Extra Cost If all young stud males tested:

  20 young males/stud sire

- Break even: $817 / 20 = $41 per DNA test

Breakeven DNA test ($) depends on breeding program

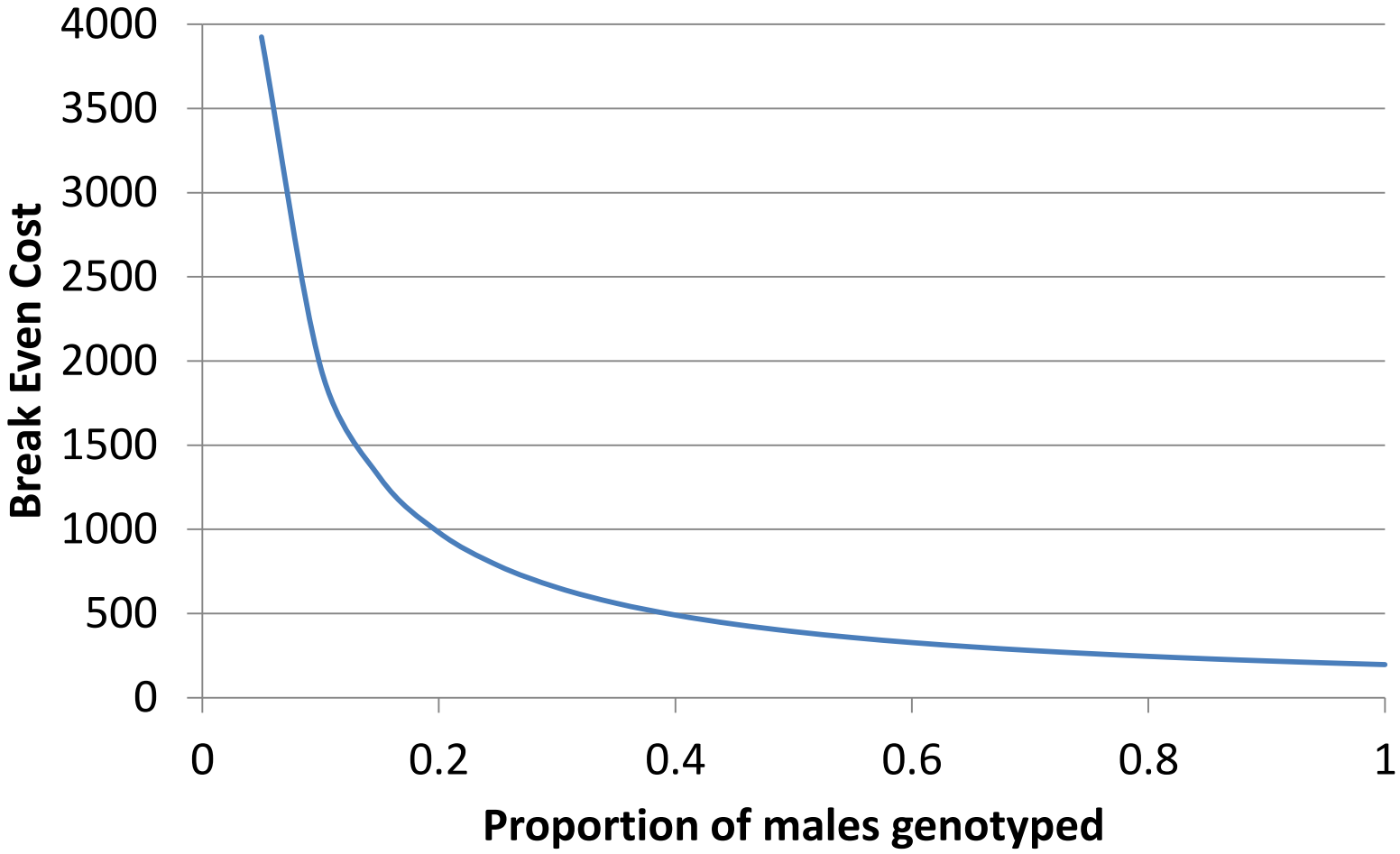
Proportion tested	**100%**		**20%**	
Age at first progeny	1yo	2yo	1yo	2yo
Breakeven ($/test)	196	83	981	415

- assumes 40% males sold as rams

% males born sold as rams	**40%**		**20%**	
Age at first progeny	1yo	2yo	1yo	2yo
Breakeven ($/test)	196	83	98	41

- assumes 100% of males tested

Breakeven cost and proportion genotyped (no loss assumed!)



1yo male, 2yo female, Fine10% + SS, 40% males sold as rams

une

What increase in price received per ram sold do you need to cover costs?

Total ram lambs weaned	**200**	**200**	**200**	**200**
% DNA tested	20	100	20	100
nr tested (for use in nucleus)	40	200	40	200
Total test cost	2,000	10,000	2,000	10,000
% sold as flock rams	20	20	40	40
nr rams sold	40	40	80	80
Cost of test per ram sold	$50	$250	$25	$125

2 stage selection

How many rams to genotype?

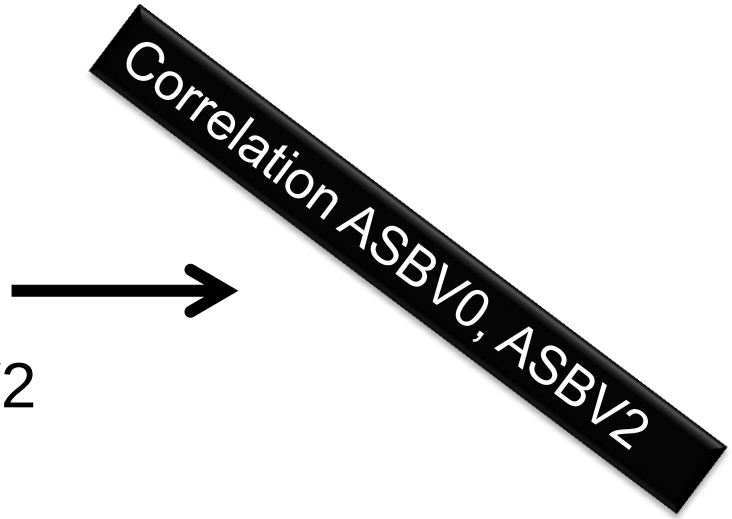
All have a breeding value at stage 1 ASBV0

Only some get extra info ASBV1

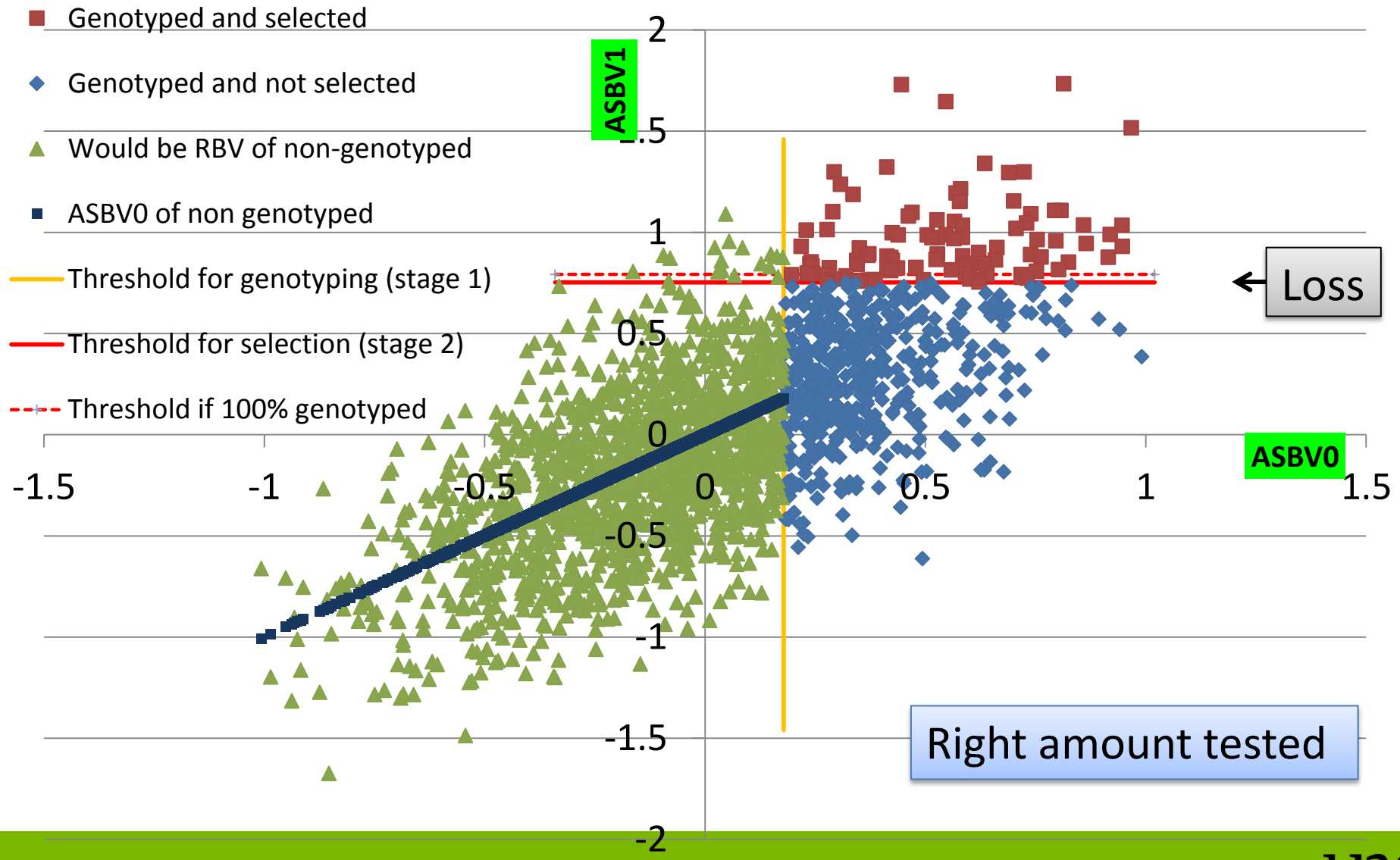
Important parameters:

ASBV0 accuracy

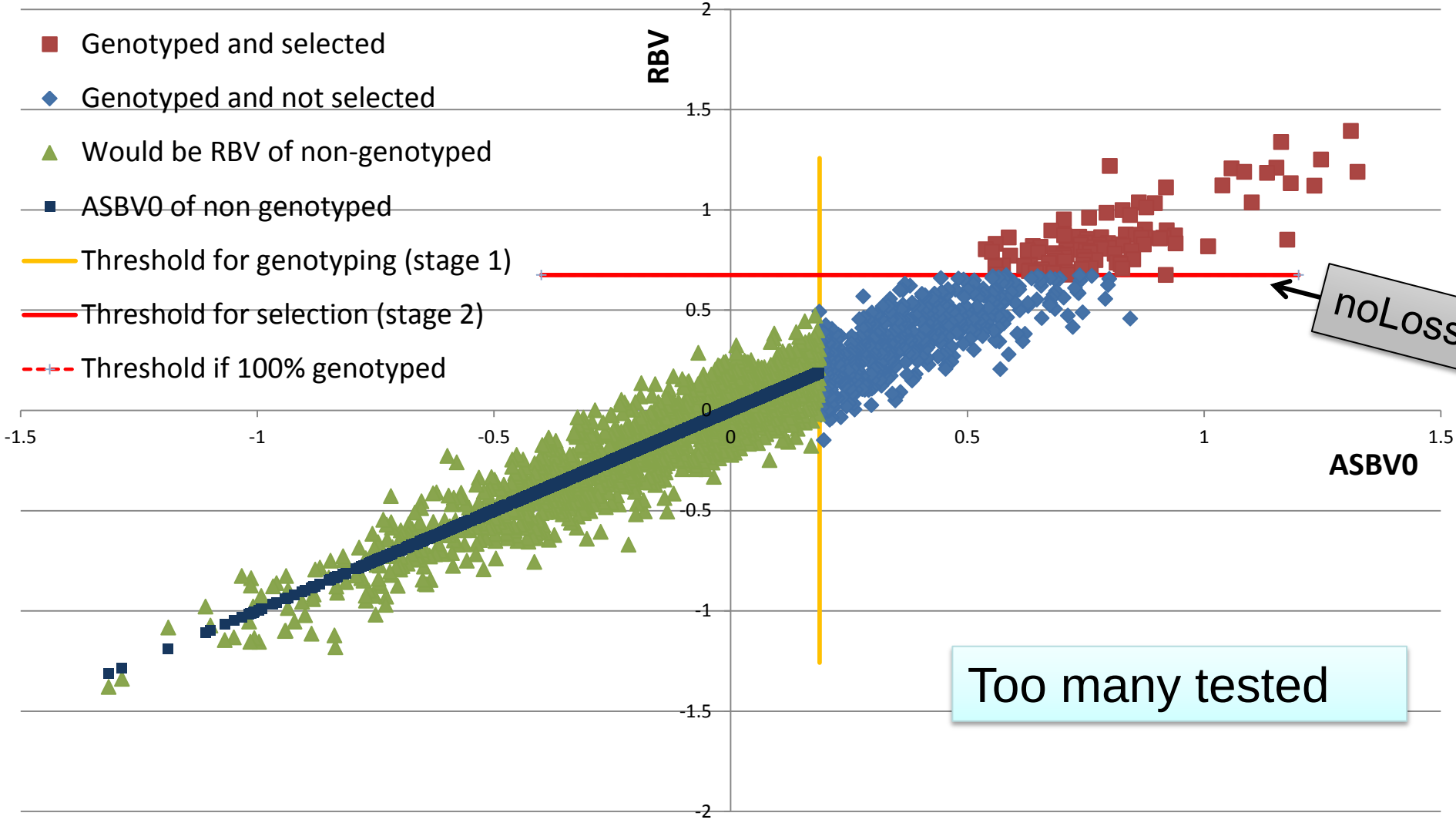
added accuracy ASBV1 → ASBV2



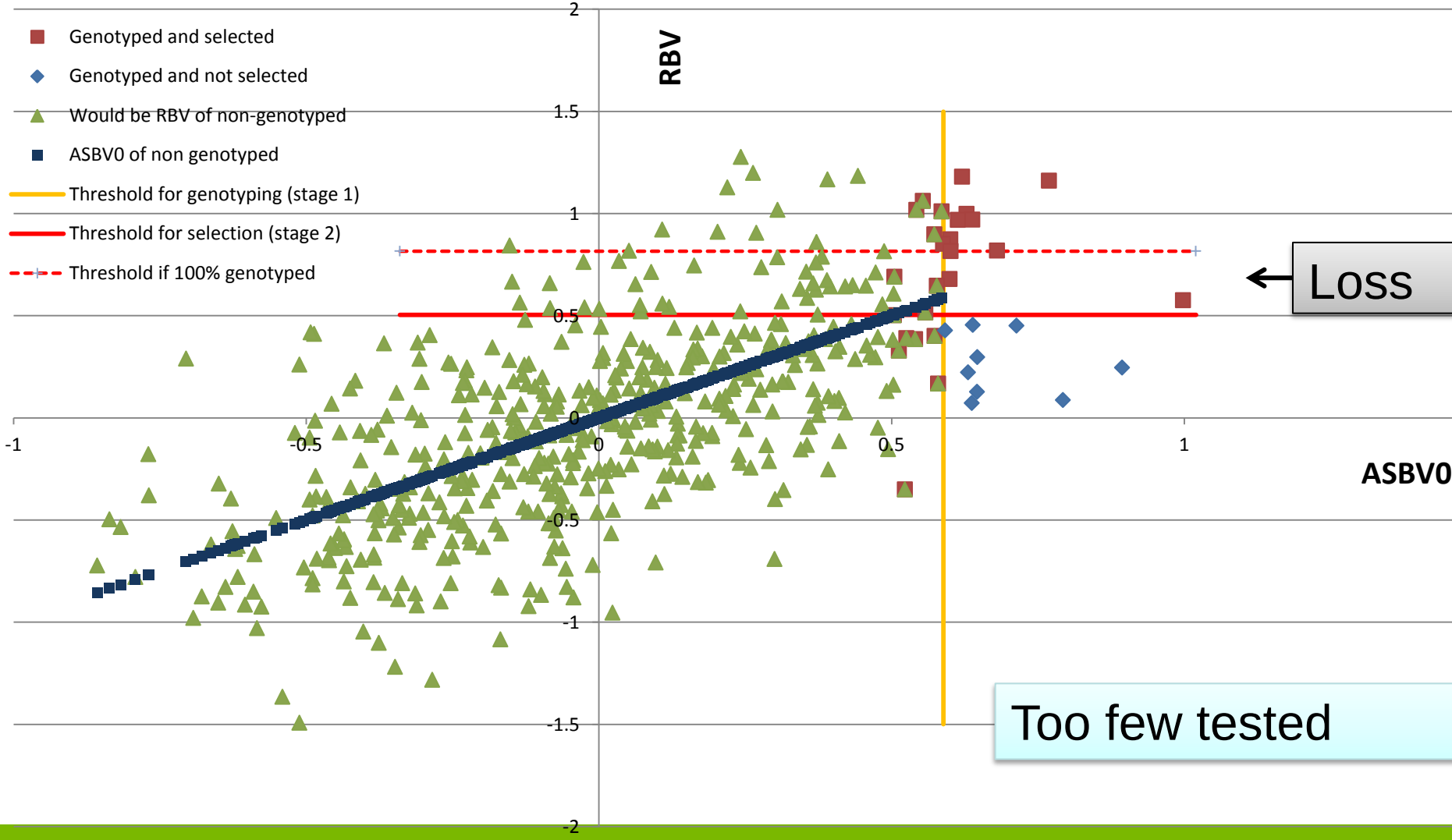
30% genotyped, 5% selected, correlation ASBV to RBV of 0.7



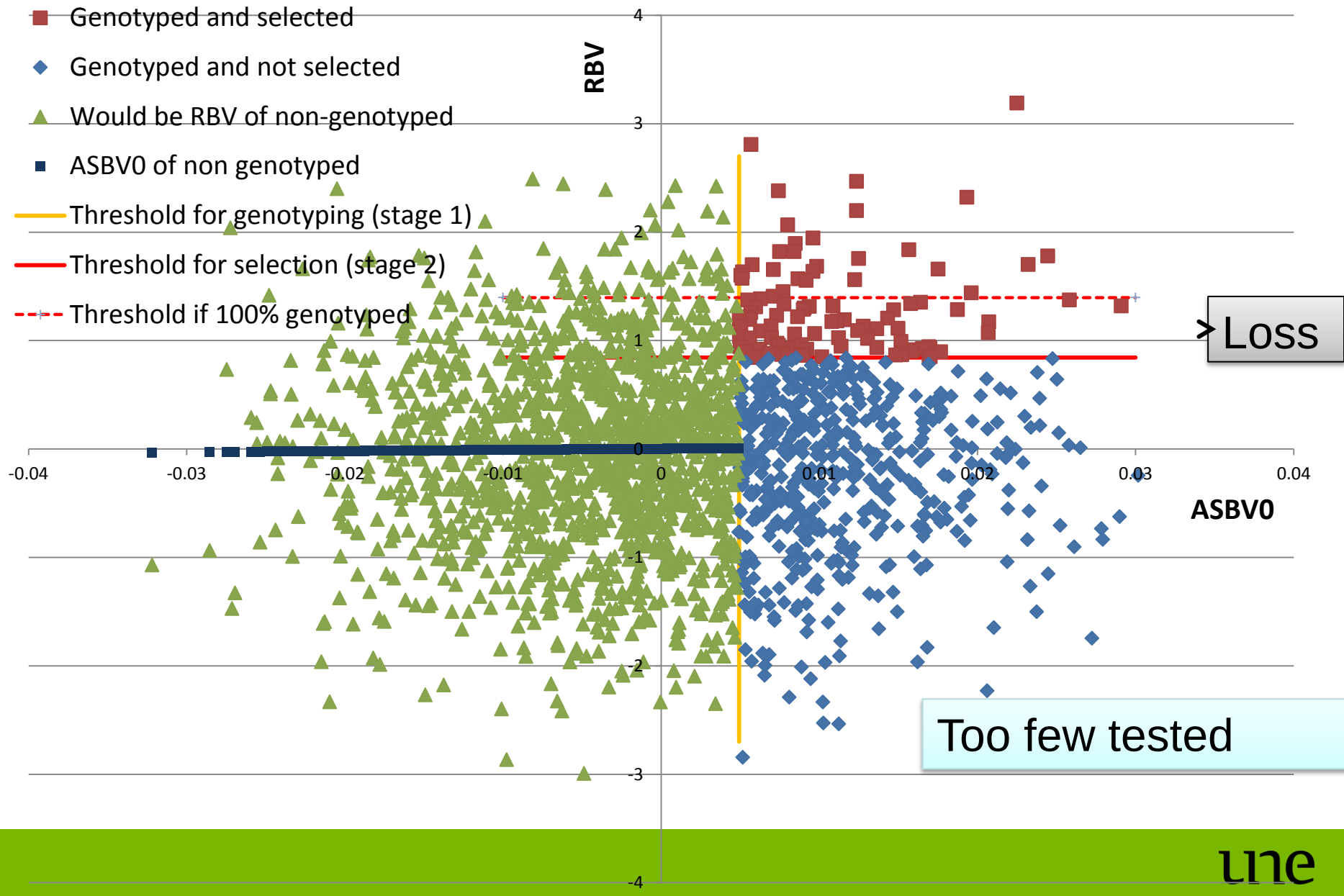
30% genotyped, 5% selected with very high correlation ASBV to RBV



Very low proportion tested



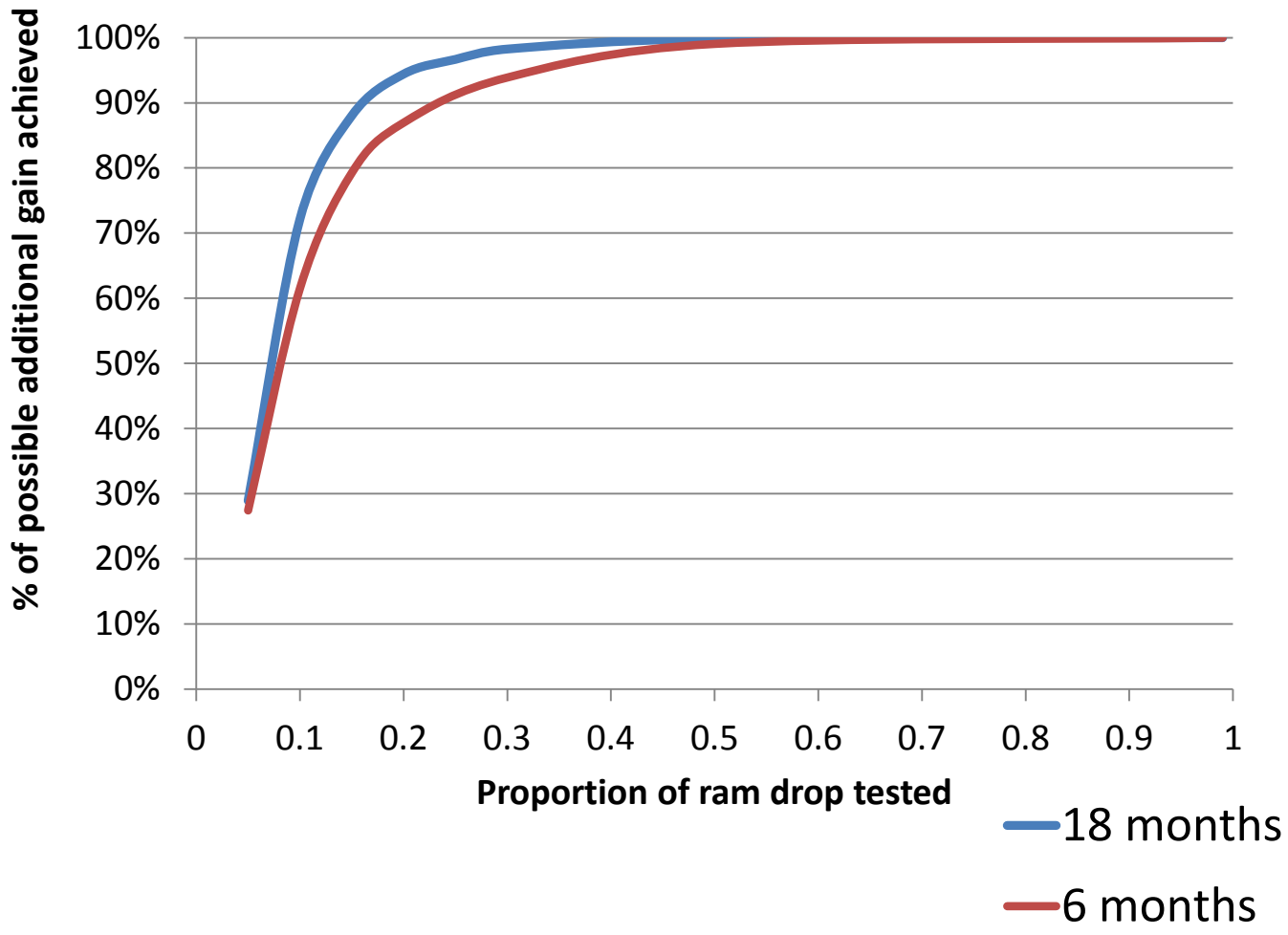
$r_{ASBV0} = 0.01$, $r_{GBV} = 0.90$, $r = 0.01$



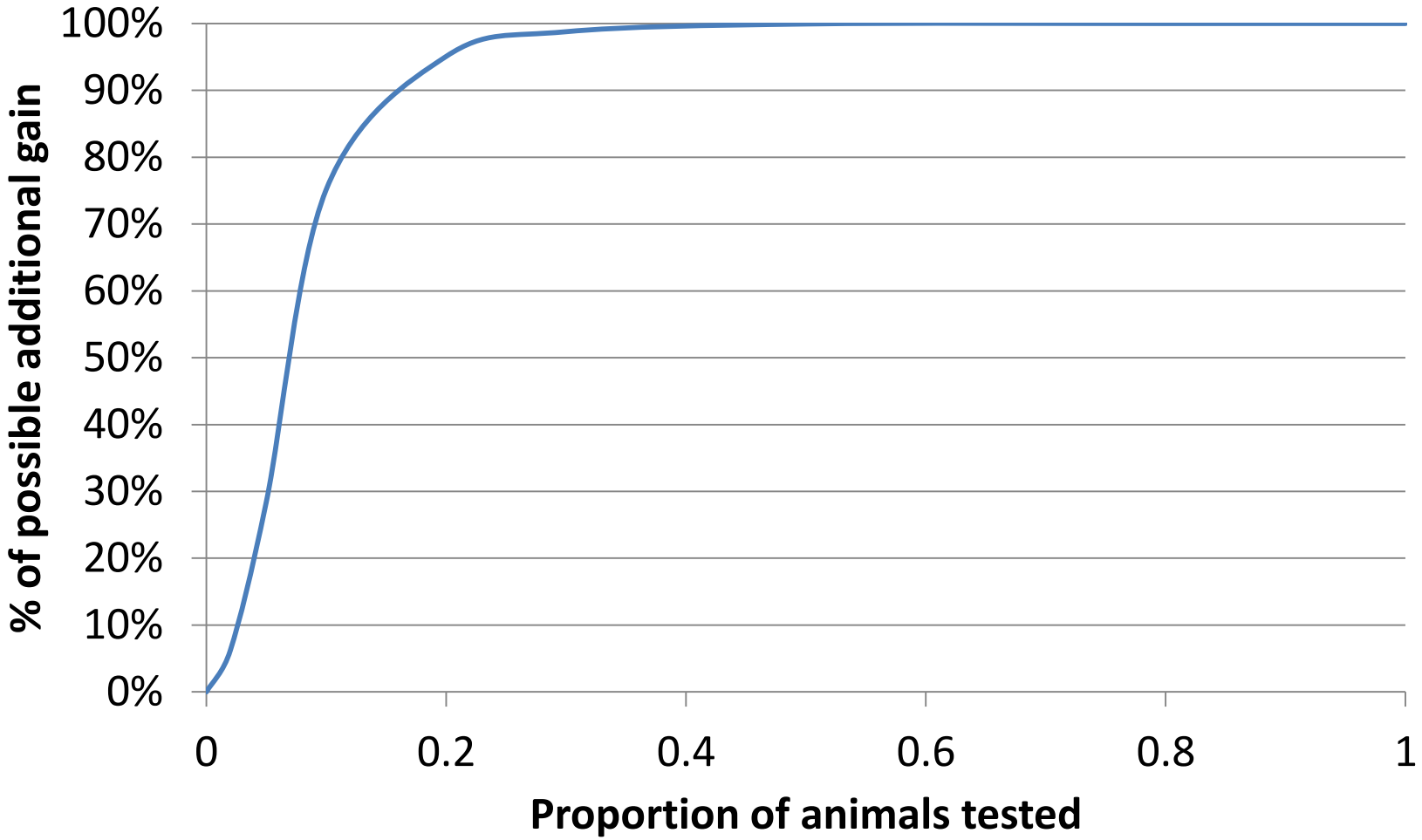
Low ASBV acc% & high GBV

ASBV0	0.20
GBV	0.50
ASBV1	0.52
correlation ASBV0-ASBV1	0.38
prop genotyped	0.3
prop selected final	0.05
Selection Differential	0.96
SelDiff 100% genotyping	1.08
SelDiff 0% genotyping	0.40
% of possible additional gain	82%

Testing 20% of drop gives most of benefit

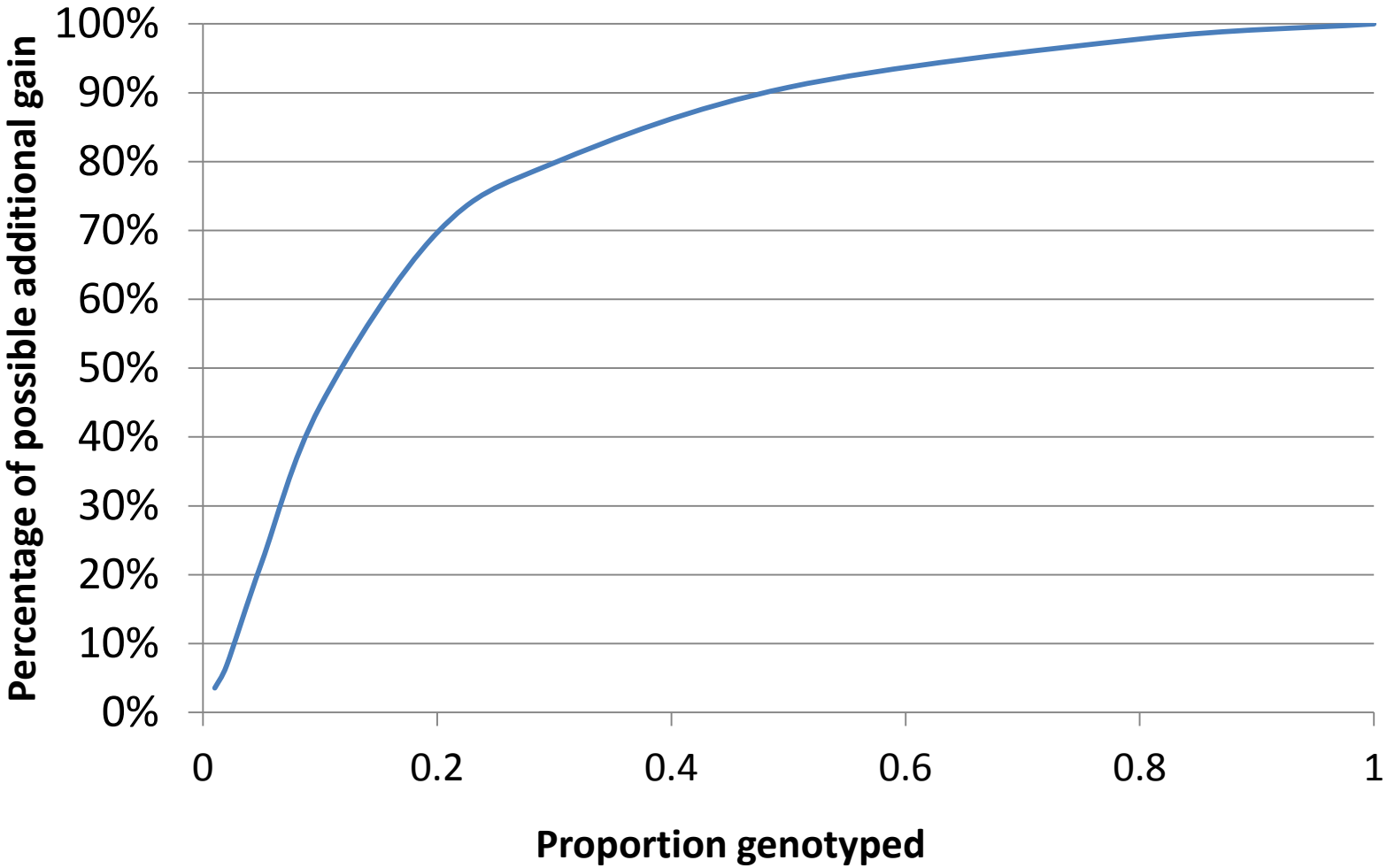


% gain compared with 100% genotyping
ASBV0 0.34, GBV 0.39, ASBV1 = 0.50, **r = 0.7**



At high(ish) correlation between ASBV and RBV only need to genotype ~20%

% gain compared with 100% genotyping
ASBV 0.10, GBV = 0.39, ASBV1 0.40, **r = 0.25**



At low(er) correlation between ASBV and ASBV1 need to genotype more

summary

- Can calculate additional gain on a per ram basis, assuming returns in commercial progeny

- Those figures depend on
  - Additional accuracy
  - Age structure
  - Flock parameters such as weaning rate, mating rate, proportion sold
  - Can have strategies to save costs, e.g. test top 20%