GET WHAT YOU WANT NOW: BREEDING FOR FASTER NET GENETIC GAIN

SGS

Optical Fiber Diameter Analyser (OFDA100)
Micron Test Report

Little Creek Farm
321 Hardscrabble Road, North Salem
NY, US 10560

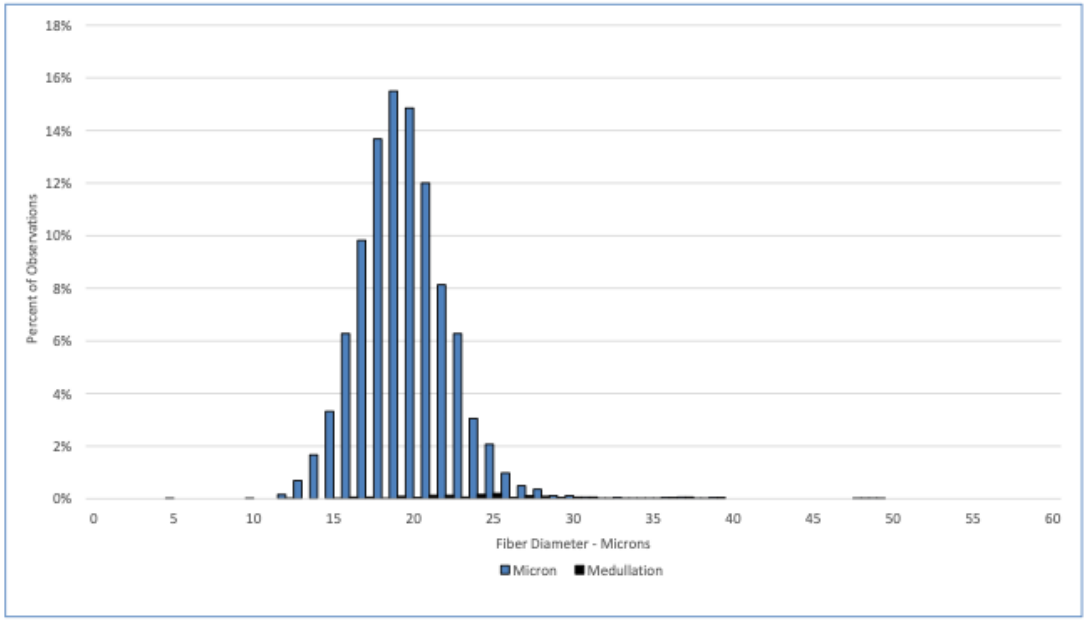
Date: 31-May-23
Shear ID: 247940
Test No: 611719

Animal and Sample Description

Animal Name:	SNOWMASS MARVELOUS OBLIVION	Date of Birth (Age):	7-Nov-20
Registry #:	36061136	Sample Location:	GRID
Breed:	Huacaya	Sample Date:	29-Apr-23
Sex:	Male	Previous Shear Date:	30-Apr-22
Colour:	100 - White	Total Fleece Wt (lbs):	8.00

Laboratory Data

Mean Fiber Diameter:	19.6 microns	Mean Staple Length:	103 mm
Standard Deviation:	2.9 microns	Length Standard Deviation:	2.8 mm
Coefficient of Variation:	15.0 %	Length Coefficient of Variation:	2.7 %
Spin Fineness:	18.2 microns	Mean Curvature:	54.9 deg/mm
Fibers Greater Than 30 microns:	0.4 %	SD Curvature:	20.5 deg/mm
Comfort Factor:	99.6 %	Medullated Fibers:	1.8 %



How do you breed to produce animals with the genotypes to produce exactly the fleeces you want?

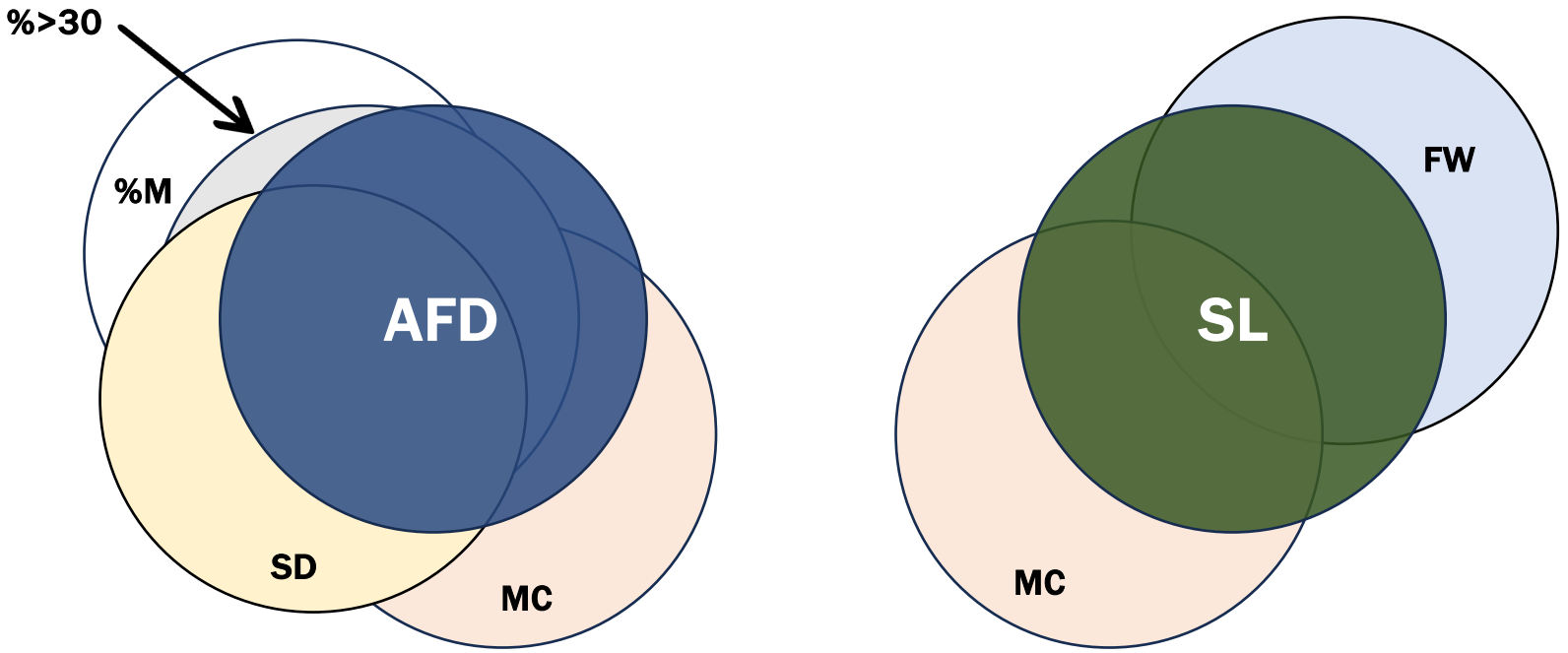
- Many traits are linked, so changing the results for one changes the results for others.
- Not all of these linkages are favorable.
- Our histogram measurements aren't designed to help us manage this.

Things we need to specify

- What traits we want to improve *and*
- What traits we don't want to change

These provide the latitude and longitude of our breeding "map"

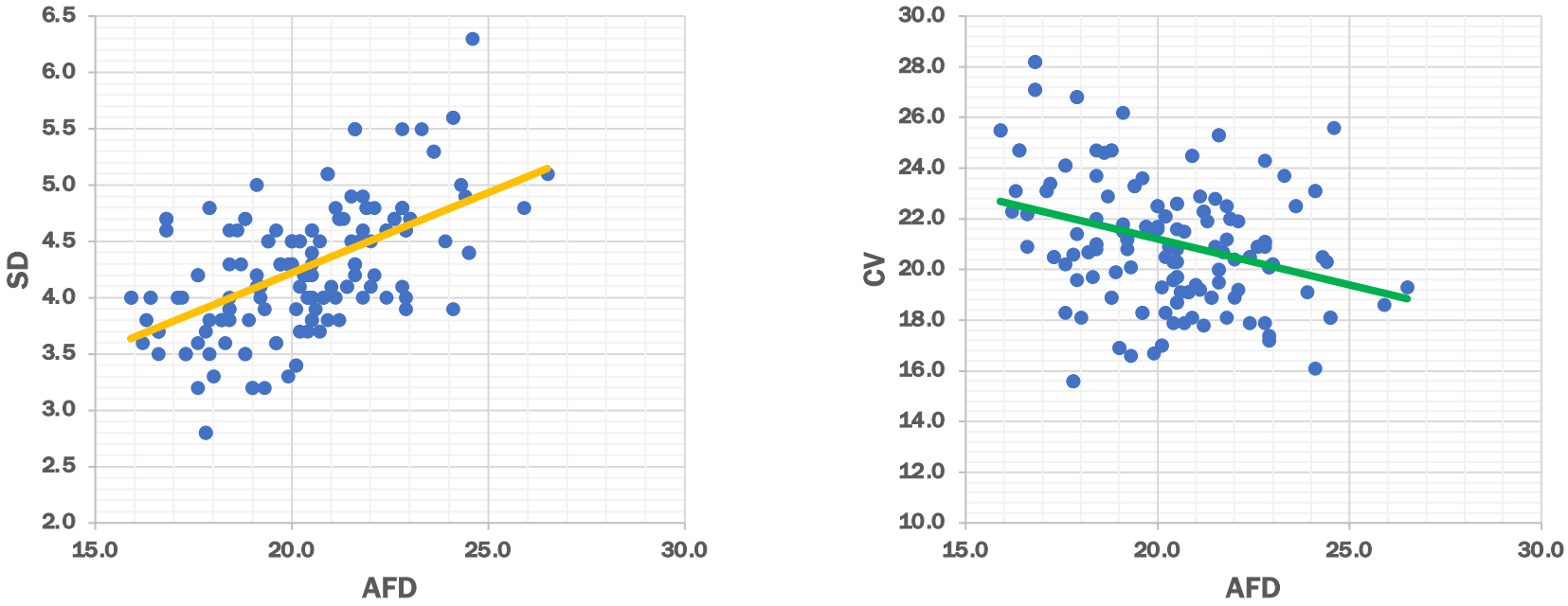
Why Are Traits Linked?



- Individual genes can affect more than one trait (pleiotropy)
  - The way we measure traits can also introduce links
- But as long as traits aren't perfectly correlated, we can manage them separately

The way we choose to describe and value traits can affect our understanding of trait linkages

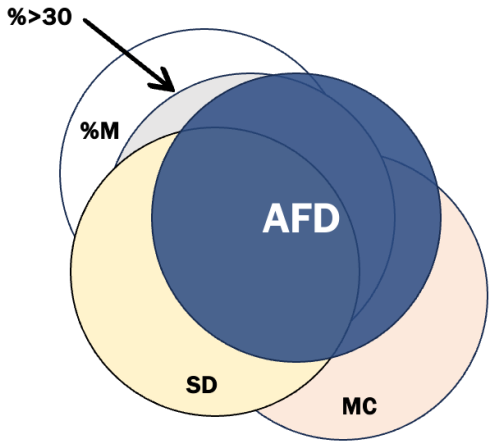
Relationship between AFD and SD (left graph) and CV (right graph) for 155 white Huacaya males



How would you describe the relationship between AFD and uniformity among animals in this group? Are the coarser animals more or less uniform?

- We have a relatively high ability to manage genotypes for SD, MC and %M independently of genotypes for AFD

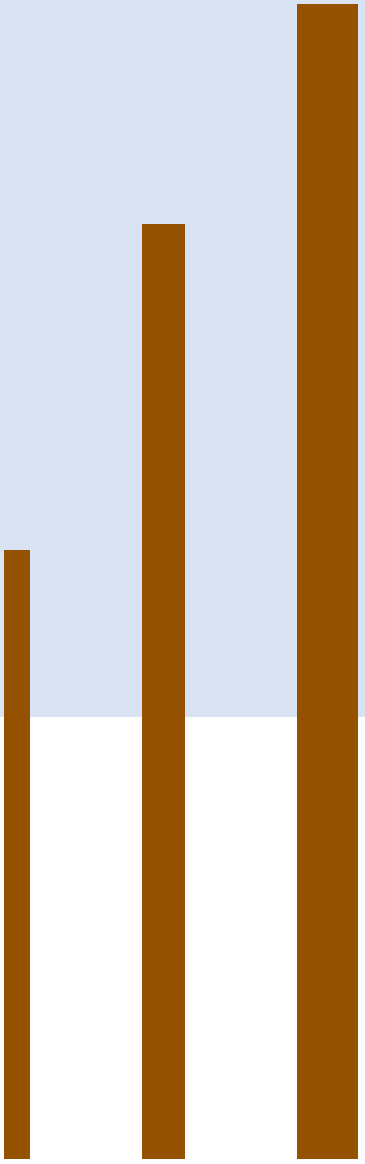
- We have little ability to manage genotypes for %>30 independently of genotypes for AFD. *Is there a better measure available to inform the search for genes that influence strength of primaries?*



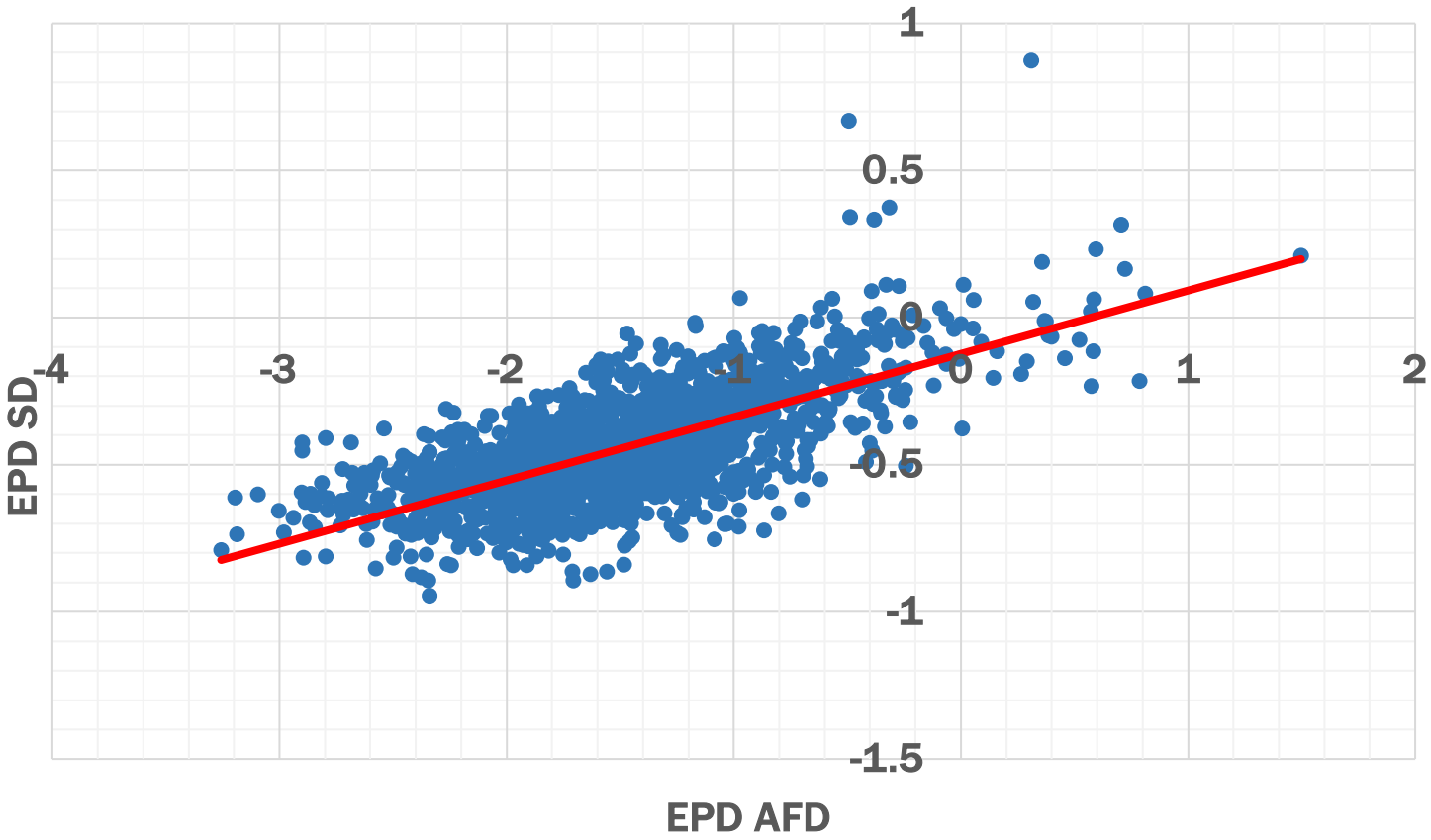
Getting What You Want Without Changing Your Animals' Genetics for AFD

Why there is a link between AFD and SD in histogram results

- Hair growth occurs along both length and breadth
- For any given genotype, nutrition that causes faster growth will tend to increase length and breadth in a proportionate manner
- This is why adult animals' CVs tend to be stable relative to AFD. It is also why SDs go up and down with AFDs.
- Breeding for uniformity requires separately targeting the genetics for AFD and SD.



How to use this graph to understand the relationship between EPDs for AFD and SD

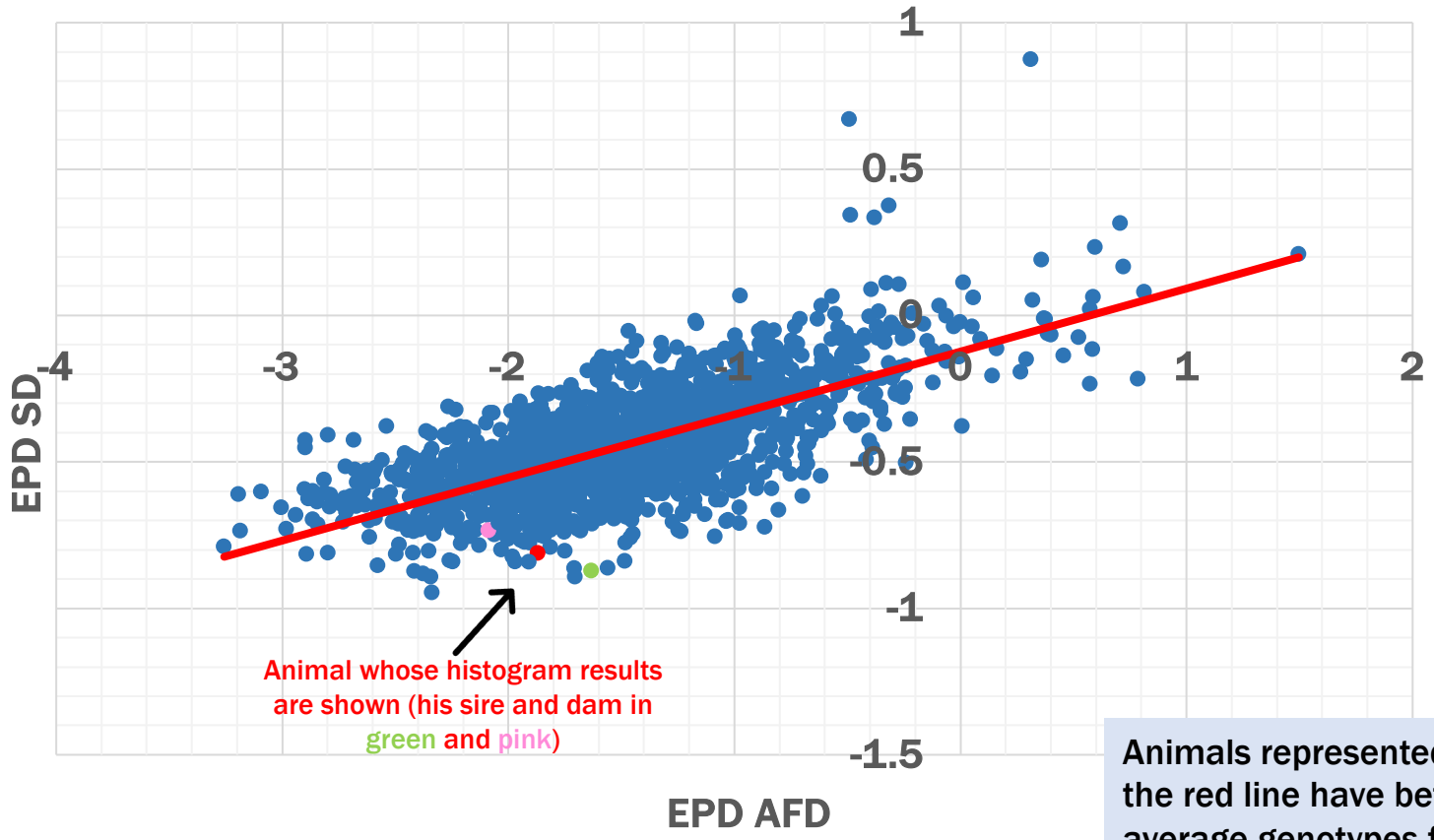


- The line describes the relationship between EPDs for SD and AFD for white animals in my herd. It has a positive slope: we can see that higher EPDs for SD (a negative) are associated with higher EPDs for AFD (which can be a negative or a positive). These are linked traits.

- We can also see that individual animals (represented by blue dots) can have a more favorable or less favorable genetic combinations for these two traits. This means we can select to eliminate the link if we want to! Or we can set a goal to improve one trait relative to another.

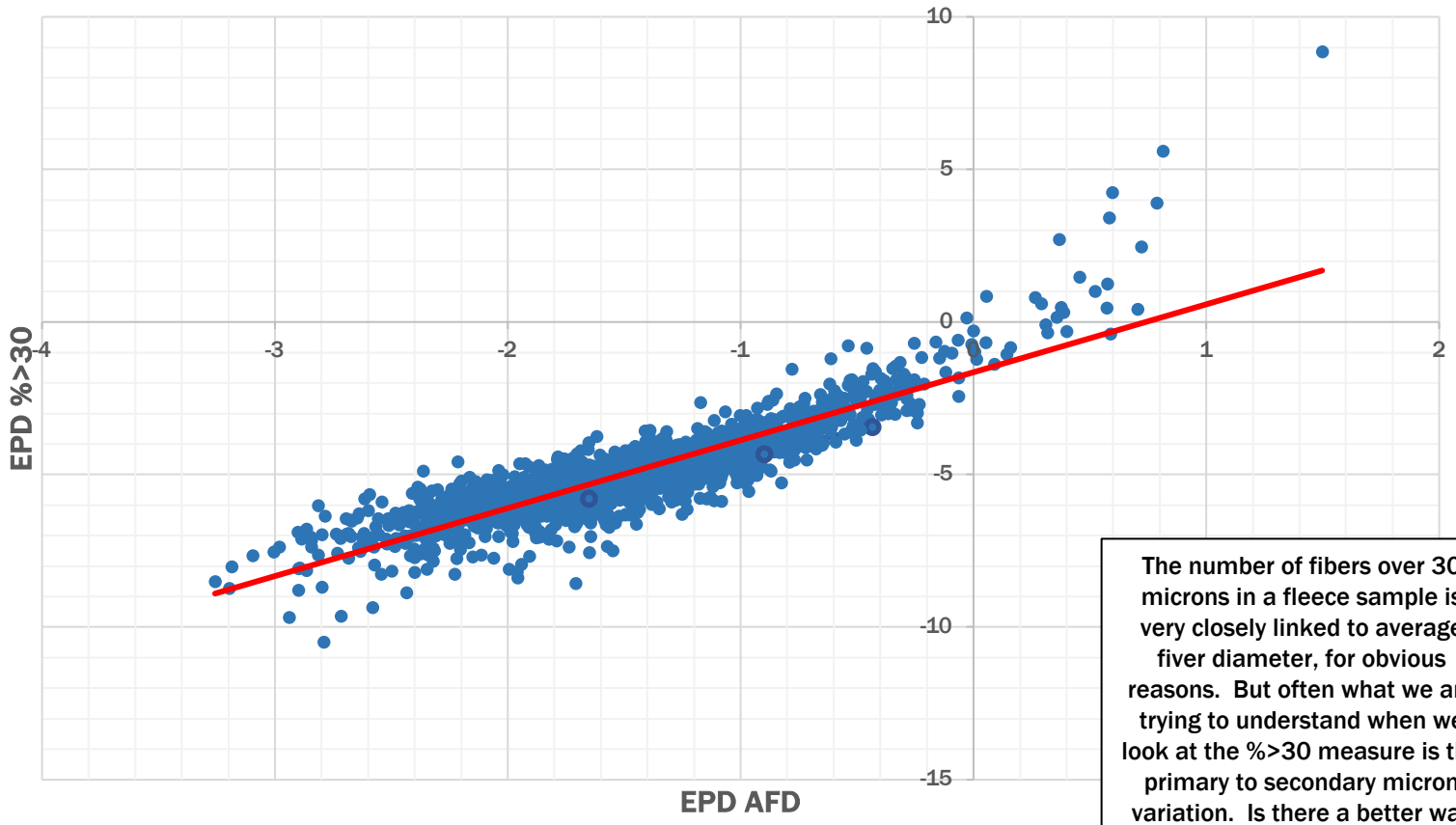
Mean Fiber Diameter:	19.6 microns
Standard Deviation:	2.9 microns
Coefficient of Variation:	15.0 %
Spin Fineness:	18.2 microns
Fibers Greater Than 30 microns:	0.4 %
Comfort Factor:	99.6 %

Here is how we bred to produce the animal whose histogram results are shown at left



Animals represented below the red line have better than average genotypes for micron uniformity relative to their genotypes for fineness.

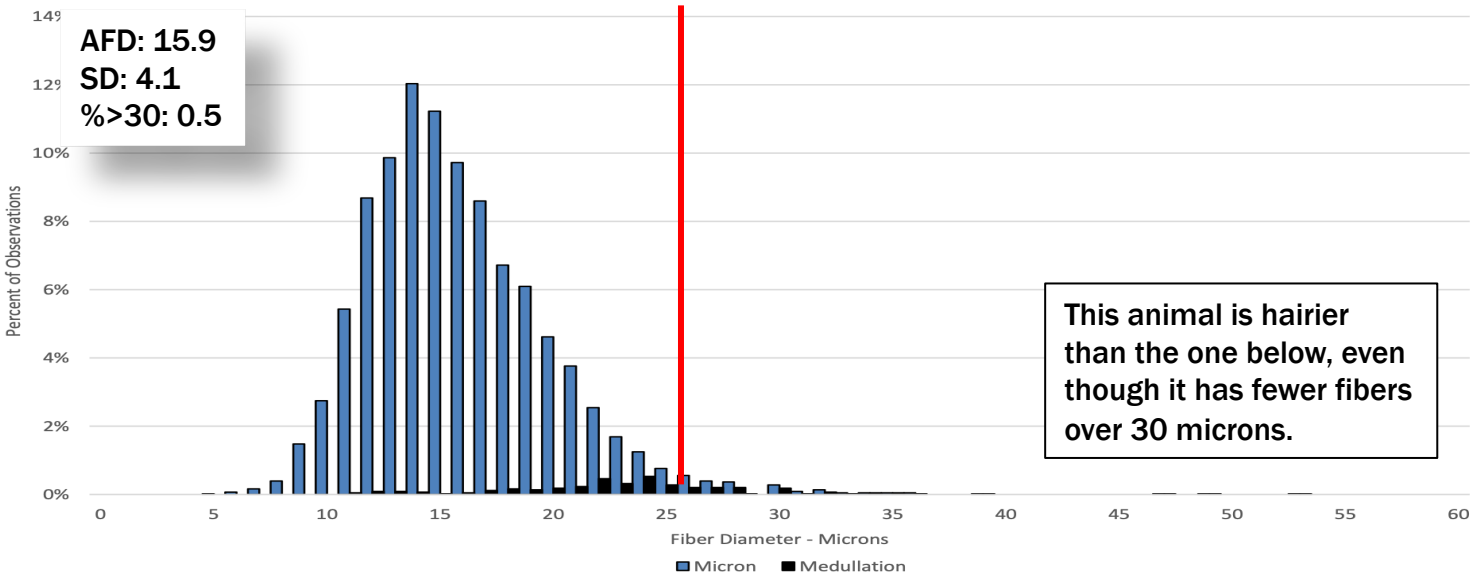
It's harder to breed for traits separately when they are tightly linked. But changing how we describe a trait may help reveal opportunities



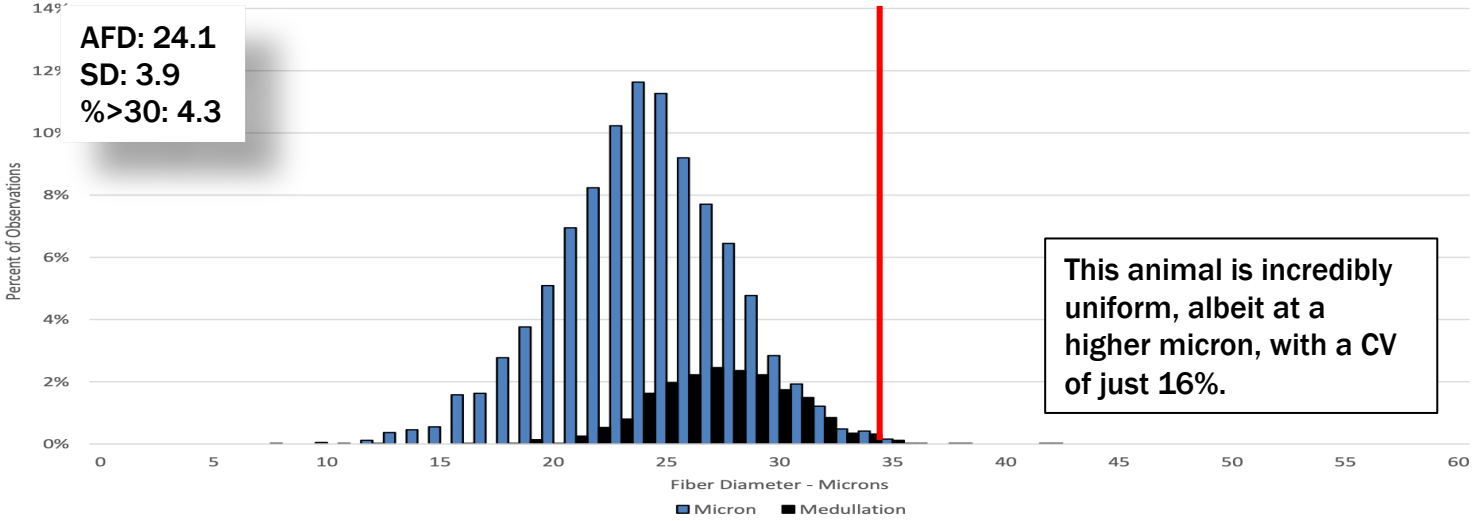
The number of fibers over 30 microns in a fleece sample is very closely linked to average fiver diameter, for obvious reasons. But often what we are trying to understand when we look at the %>30 measure is the primary to secondary micron variation. Is there a better way to understand this aspect of a fleece from a histogram?

What if we tried a different measure – like this one for instance?

The red line is drawn at +10 microns above the AFD



This animal is hairier than the one below, even though it has fewer fibers over 30 microns.

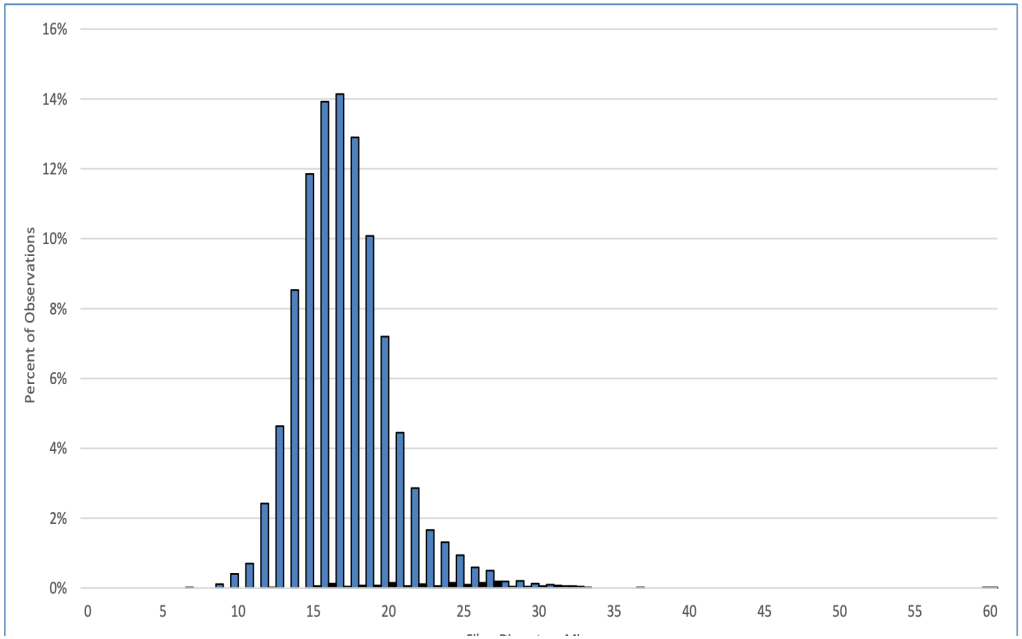


This animal is incredibly uniform, albeit at a higher micron, with a CV of just 16%.

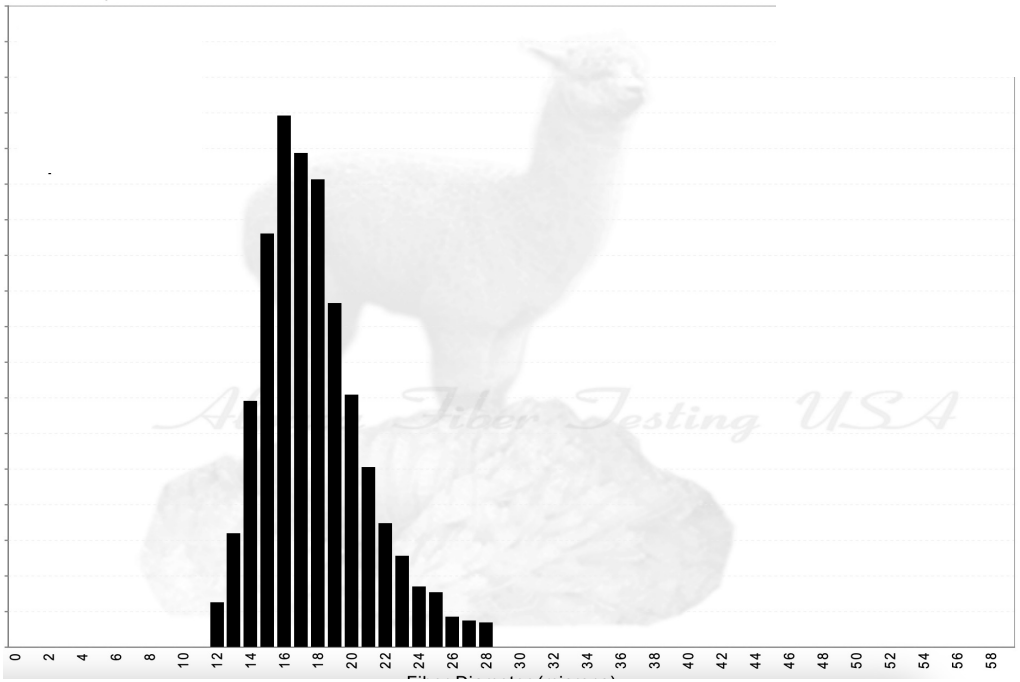
A Cautionary Reminder

- The OFDA 100 and OFDA 2000 instruments measure different types of fleece samples and do so in different ways
- These differences are often especially salient with respect to SD and %>30
- The OFDA 2000 used with the trim setting on may exclude the strongest fibers present in the sample from the analysis. This results in a lower SD and %>30 than would be revealed by analysis of the same sample with the OFDA 100.

OFDA 100
example



OFDA 2000
Example of different animal

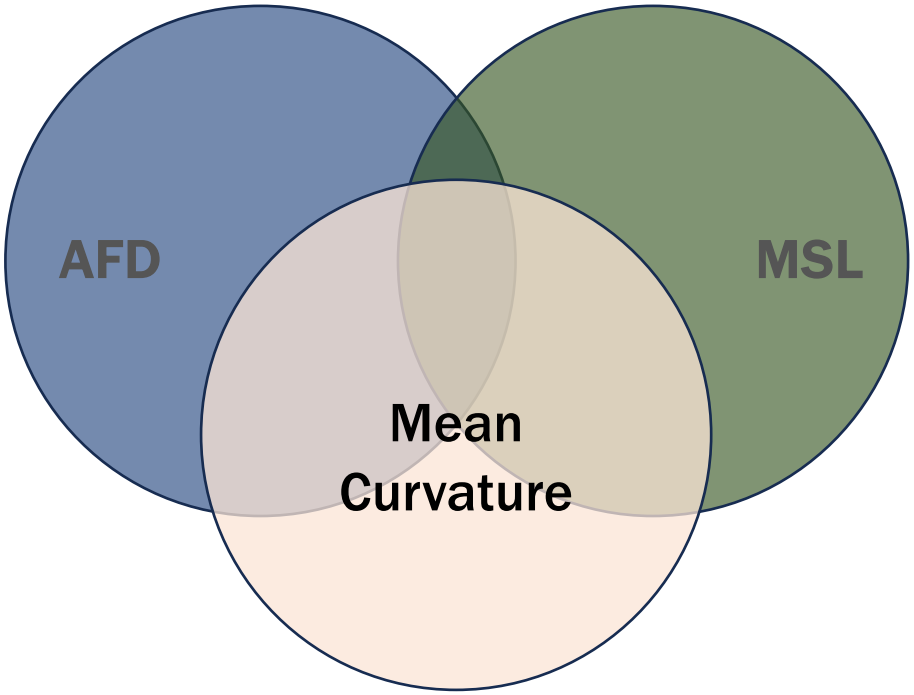


Quick EPD Hacks

To improve genotypes for uniformity breed for animals with better rankings for EPD SD and EPD %>30 than EPD AFD.

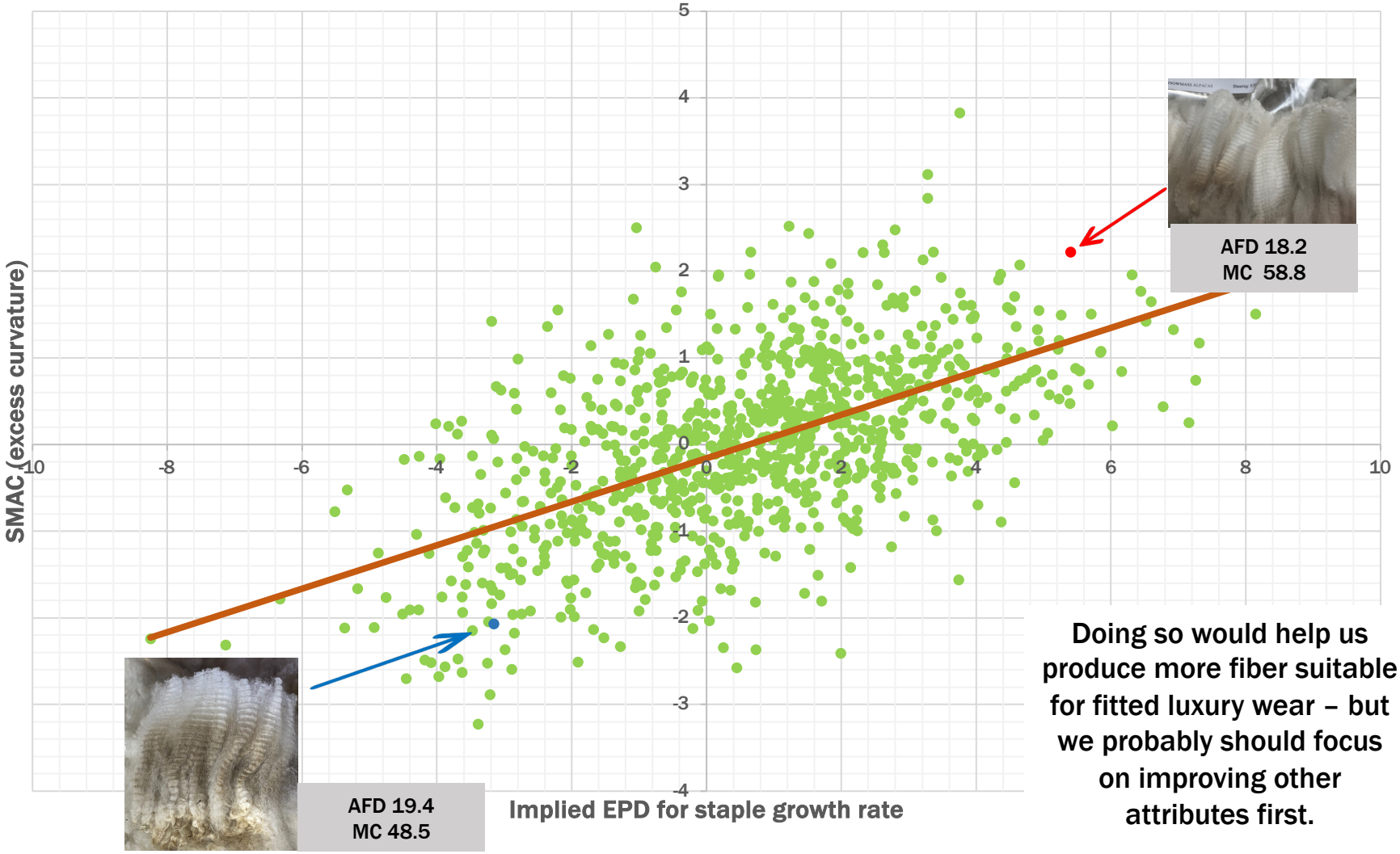
The same approach can be taken to breed for genotypes producing less medullation at a given level of fineness, but the extent of selection pressure applied by this ”hack” will be lower.

Trait	Value	Acc	Rank	Rank%	
AFD	-1.869	0.529	1,665 of 30,965	5.38%	Top 10%
SDAFD	-0.812	0.529	43 of 30,965	0.14%	Top 1%
SF	-2.122	0.572	952 of 30,965	3.08%	Top 5%
%F>30	-5.551	0.576	4,344 of 30,965	14.03%	Top 15%
MC	6.111	0.519	448 of 30,965	1.45%	Top 5%
SDMC	2.23	0.548			
%M	-3.855	0.478	2,520 of 30,965	8.14%	Top 10%
MSL	-1.595	0.457	22,922 of 30,965	74.03%	
FW	0.609	0.412	3,375 of 30,965	10.9%	Top 15%
BW	-0.41	0.134			



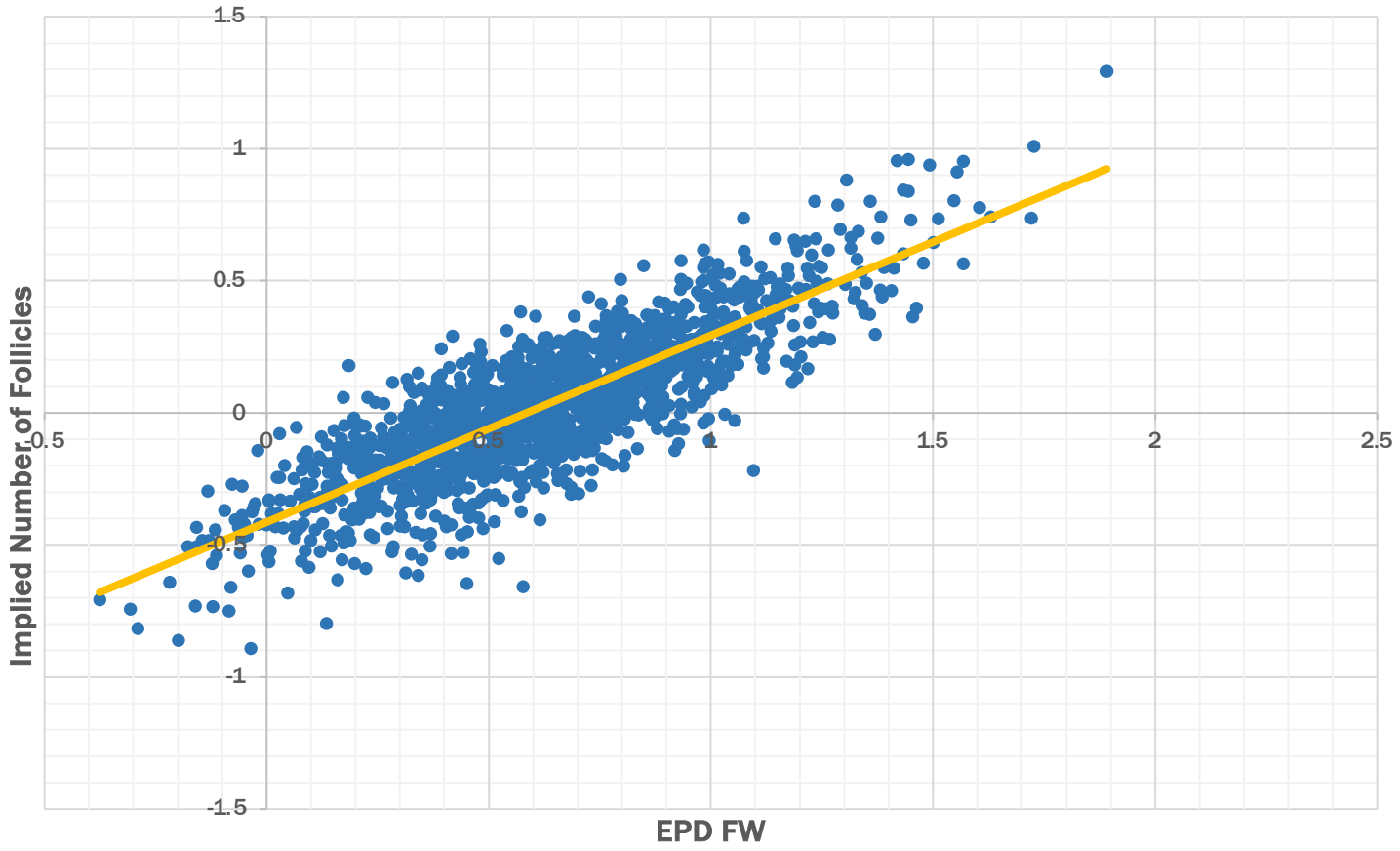
Curvature is a function of AFD and MSL, but also the result of other attributes of the hair that we do not directly measure

You can see that it is possible to breed for higher curvature fleeces relative to staple growth rates. The same is true relative to AFD. But is this a good use of our breeding "time"?



Doing so would help us produce more fiber suitable for fitted luxury wear – but we probably should focus on improving other attributes first.

What about fleece weight?



This graph shows that differences in the implied number of follicles present explain about half the variation we see in fleece weights. Most of the rest is explained by variations in staple length. You can breed to vary the genetics for fleece weight, staple length, number of follicles and AFD independently.

Traits Linked With Phenotypic Color

Curvature

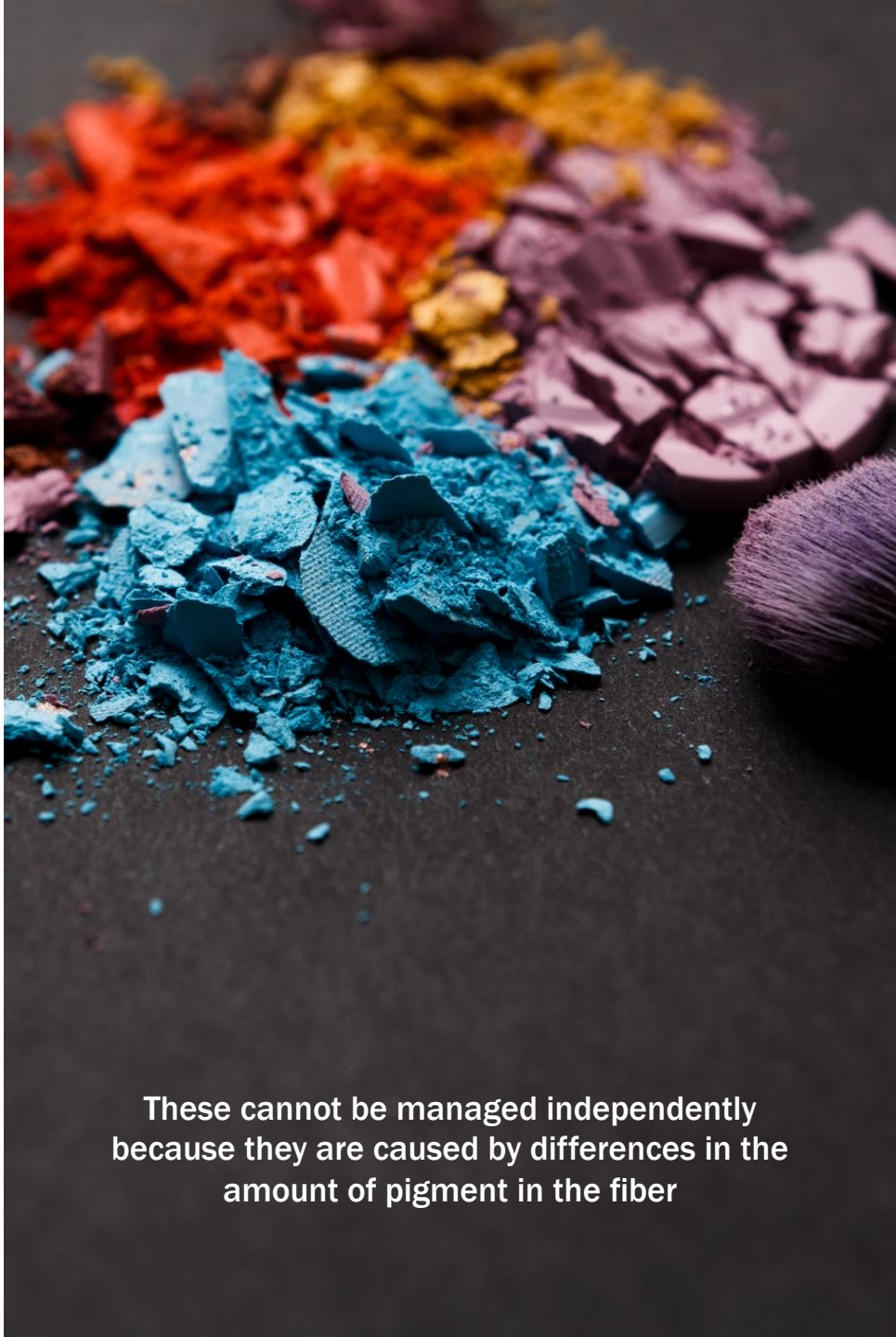
Effect: Hairs with more pigment in them will have lower curvature all else constant

Keep in mind: Offspring of different colors than their parents will have fleeces of different curvature and crimp style because of this

AFD

Effect: There is evidence that deep pigmentation may place a floor on how low an AFD is possible. The interior of the hair needs to be broad enough to contain sufficient pigment to produce a color we identify as black, for instance.

Keep in mind: This is only an issue if you wish to produce the darkest colors *and* the finest AFDs – this may be a tough trait pairing to target.



These cannot be managed independently because they are caused by differences in the amount of pigment in the fiber

Medullation is heritable, but is it worth it to breed to reduce it?

- Medullation affects dye uptake and medullated fibers are not desirable in dyed textiles in particular.
- There is evidence within our herd that the U.S. industry has been breeding for reduced medullation. Animals with genetics for higher medullation than would be predicted by their genetics for fineness are more likely to be closely related to imported animals, whereas those with genetics for lower medullation are more likely to have deeper U.S. pedigrees.
- However, medullation is not well correlated with any trait except fineness. Even the relationship between medullation and measures of uniformity is limited.
- This means selecting for it will be ”expensive” in many herds.

Remember

- Set correlated trait goals in combination, not individually. Think latitude *and* longitude:
    - ”I want to breed for AFDs below 20.0 *and* SDs below 3.5”
    - “I want to breed for shorn fleece weights above 10 lbs *with* staple length shorter than six inches in young animals”
    - “I want to breed for under 10% medullation *in* animals with grade 2 fleeces”
- Consider whether the usual measurements accurately describe what you are really trying to breed for, and if the answer is no look for an alternative measure
- Be careful about comparing phenotypic measurements produced by different instruments and from different types of samples