

# Starch Degradability

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## Starch Degradability



CHO5015:N12-387-1-B



Oh43 o2

# **Starch Studies**

## **Objectives**

- 1) Determine whether there is genetic variation for starch degradability
- 2) Determine the extent to which kernel vitreousness is related to starch degradability

## Expt. Starch B

Four near isogenic lines: Oh43  
Oh43 *su2*  
Oh43 *o2*  
Oh43 *fl2*

Harvest dates: ½ milkline (ML, ~35% DM)  
5 d post ½ ML  
10 d post ½ ML  
Black layer (~15 d post ½ ML)

Experiment design (field): RCB with 3 replicates  
Madison, 2002  
3 self-pollinated rows – 3.04 x 0.76 m  
10 plants per row

# **Procedure – Two-Stage Starch Digestion (Pioneer Hi-Bred International, Inc.)**

## **STAGE 1 - in-situ ruminal incubation**

- Two steers with ruminal cannula – 2 wk adaptation to 70% (DMB) corn silage diet
- In-situ procedure:

Corn kernels ground with Wiley Mill (6mm screen)

1.5g ground material placed in 5 x 5 cm dacron bag,  
eight replicate bags incubated for each sample

Placed in rumen for 0 and 14 h,

Removed, rinsed and dried at 62°C for 24 h

## **STAGE 2 - post-ruminal in-vitro incubation**

14-h ruminal residue subjected to 8 h incubation  
intestinal enzymatic cocktail (pepsin + pancreatic enzymes)

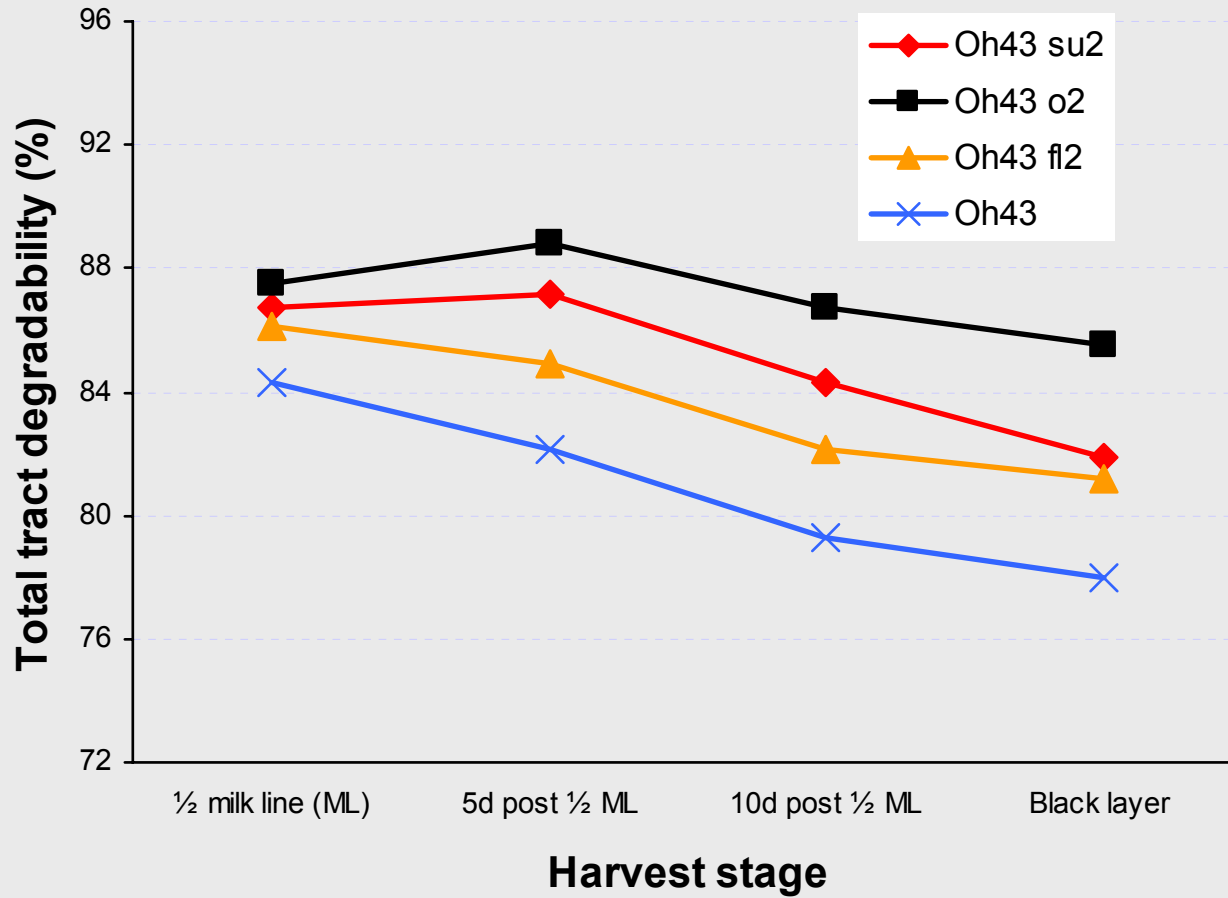
Removed, rinsed and dried at 62°C for 24 h

## **Final Action**

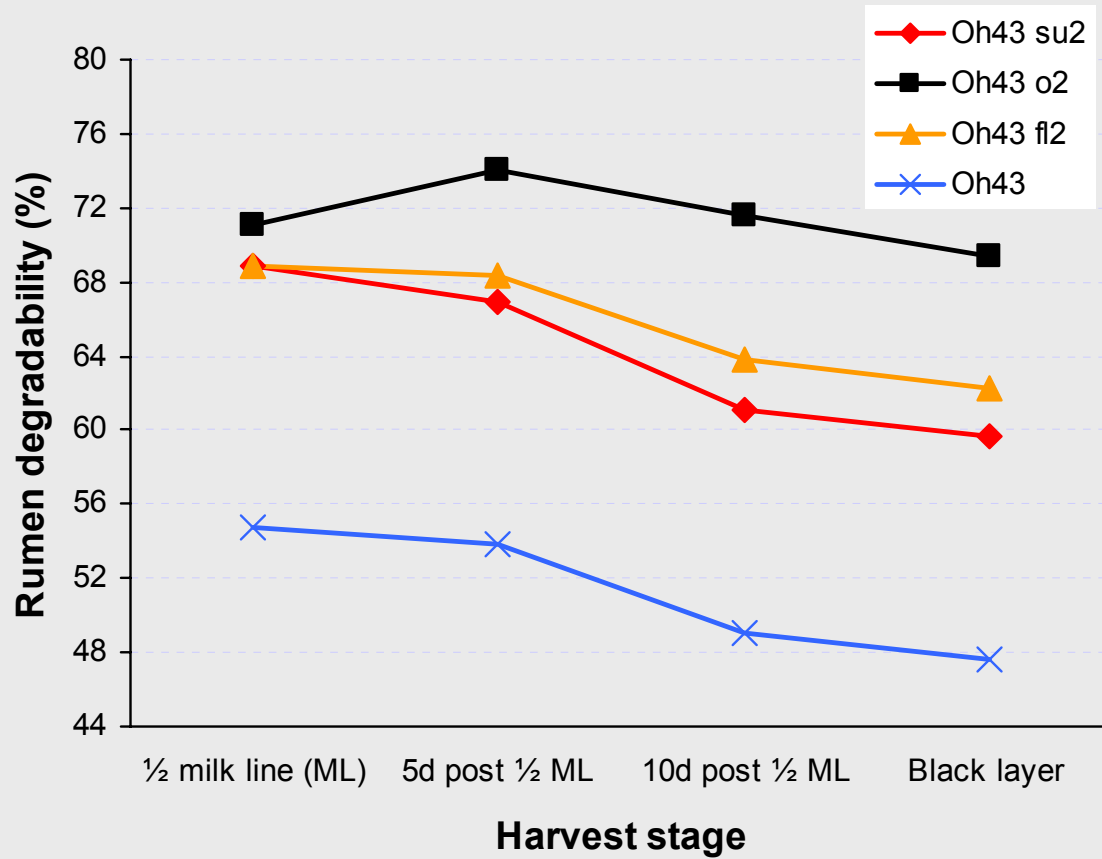
Eight replicates for DM disappearance

Eight replicated bags composited for a single starch analysis

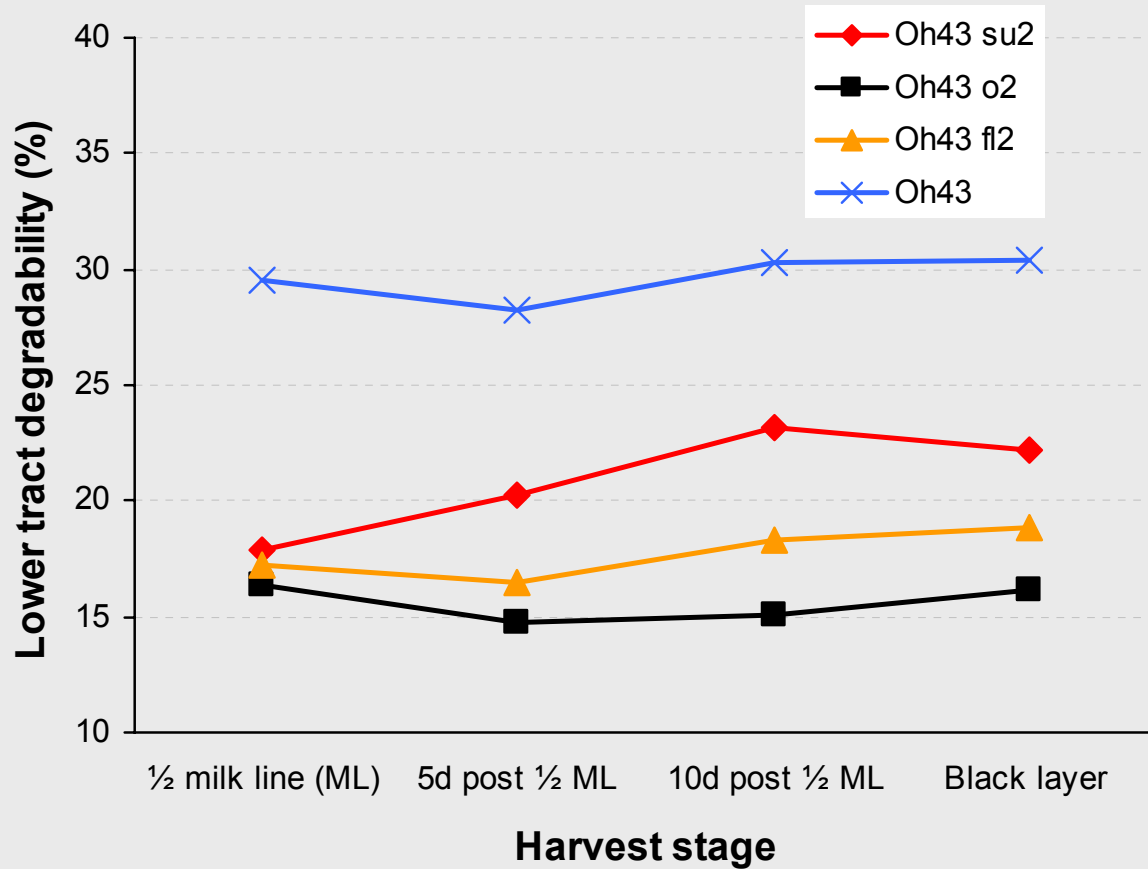
# Total Tract Degradability



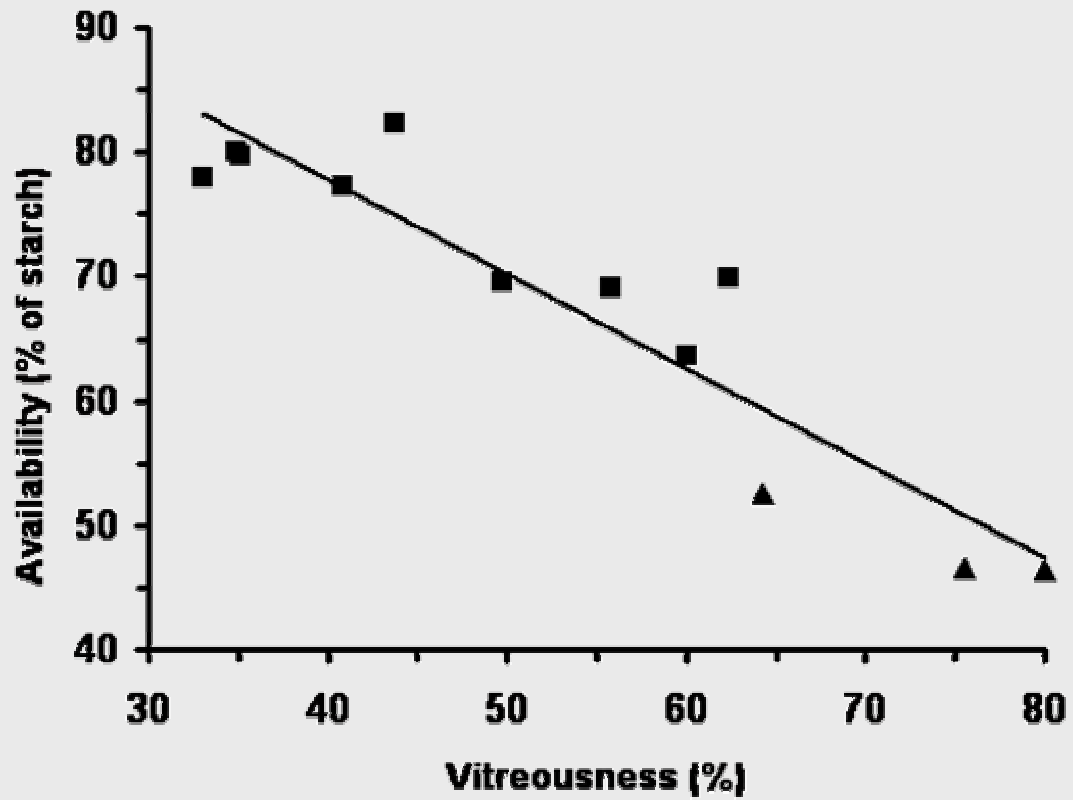
# Rumen Degradability



# Post Ruminal Degradability







[Correa et al., 2002]

## NIRS CALIBRATION STATISTICS

EQ	CONSTITUENTS	N	MEAN	SEC	RSQ	SECV	1-VR
1*	Manual vitreousness dissections	65	49.6	4.85	0.90	6.04	0.84
2	Visual vitreousness rating	59	74.4	7.07	0.78	8.08	0.73
3	Sternvert time	63	20.1	1.39	0.85	1.79	0.76
4	Sternvert total column	63	7.3	0.19	0.85	0.25	0.79
5*	Density	69	1.2	0.01	0.92	0.02	0.81

N=data points; SEC=std error of calibration; SECV=SEC of validation; 1-VR=validation RSQ

\*Equations are from combined data from Correa et al. (2000) and 24 data points added in this study.

# Expt. Starch A

Entries: 32 inbred lines and 1 population

Harvest dates:  $\frac{1}{2}$  milkline (ML, ~35% DM)  
Black layer (~15 d post  $\frac{1}{2}$  ML)

Experiment design (field): RCB with 3 replicates  
Madison, 2002  
1 self-pollinated row – 3.04 x 0.76 m  
10 plants per row

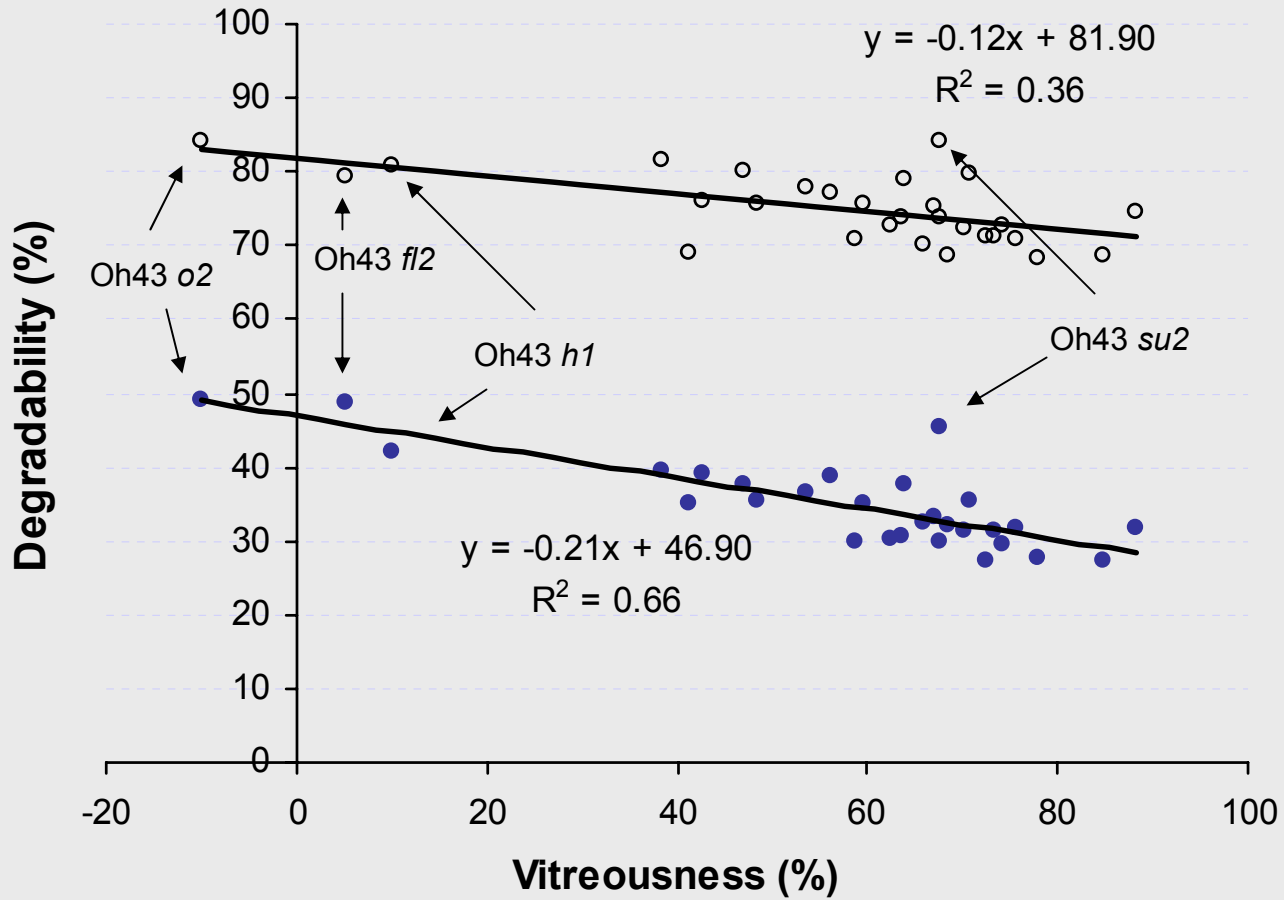
# Starch Study 1

## Entries

Oh43	AR16035:S02-447-1-B
Oh43 <i>su2</i>	AR16035:S02-611-1-B-B
Oh43 <i>o2</i>	AR16035:S02-666-1-B-B
Oh43 <i>ae1</i>	CHIS775:N1912-254-1-B
Oh43 <i>fl2</i>	CHIS775:N1912-347-1-B
Oh43 <i>h1</i>	CHO5015:N12-387-1-B
Oh43 <i>wx1su2</i>	CHO5015:N15-143-1-B
	CHO5015:N15-182-1-B
WQS C2	CHO5015:N15-8-1-B
CML176	CUBA164:2008a-23-1-B
NC398	CUBA164:S15-184-1-B
NC410	CUBA164:S15-192-2-B
NC412	CUBA164:S15-435-1-B
NC414	CUBA164:S2008a-3-1-B
NC416	DREP150:N2011d-13-1-B
B73	FS8B(T):N1802-35-1-B
W64A	UR13085:N0215-3-1-B

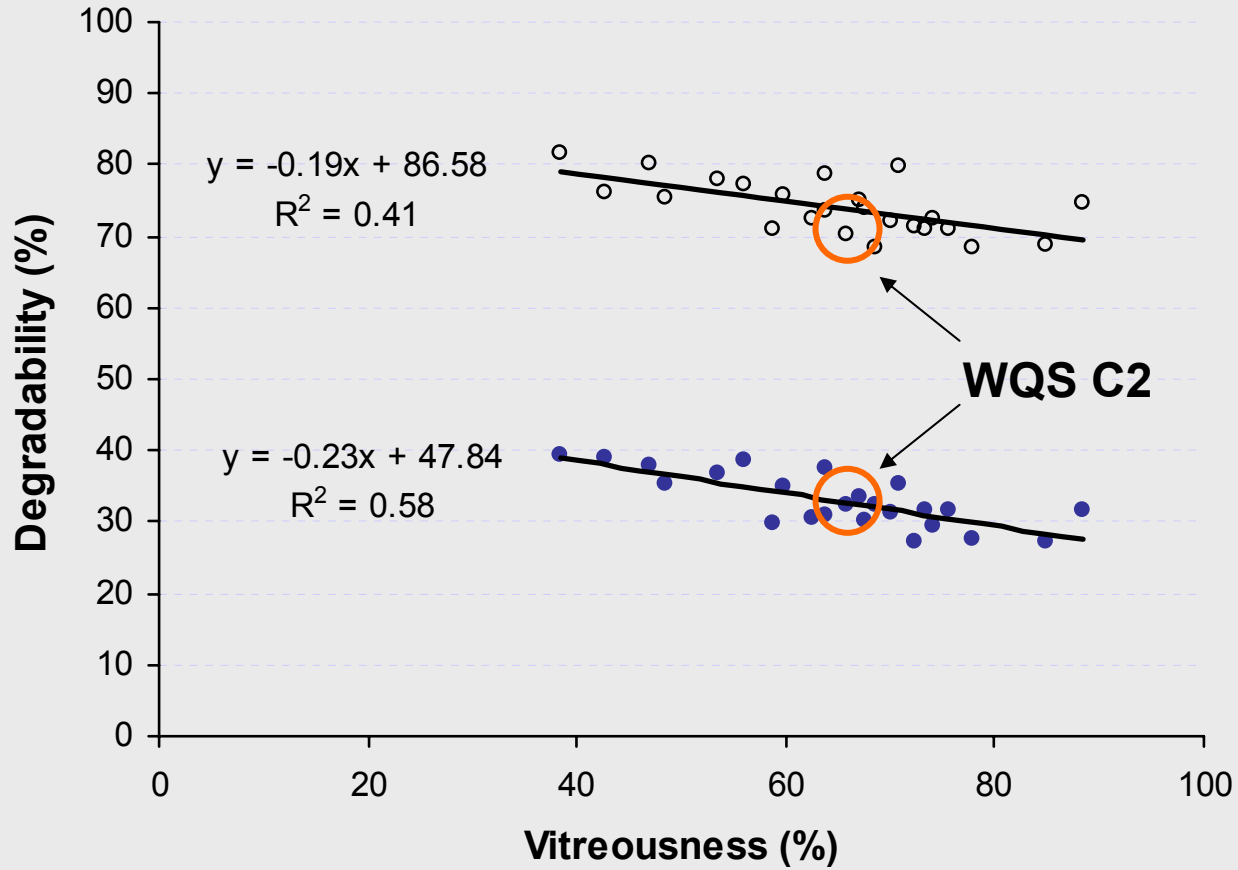
# Black Layer Stage

● Rumen in situ degradability (14h) ○ Total tract degradability



# Black Layer Stage

● Rumen in situ degradability (14h) ○ Total tract degradability



## **Conclusions**

There is genetic variation for starch degradability independent of maturity effects, and this may also relate to site of starch degradation.

Kernel vitreousness can be used as a breeding screen for ruminal and total starch degradation.

In vivo studies are necessary to evaluate the appropriate levels of ruminal versus post-ruminal starch degradation to maximize overall energy obtained from silage.