

# Characterization of Arabinoxylans and $\beta$ -glucans in Canadian Hard Red Spring Wheat Cultivars

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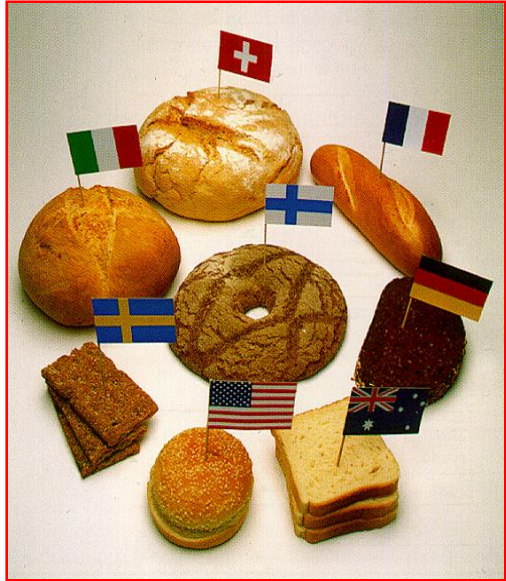
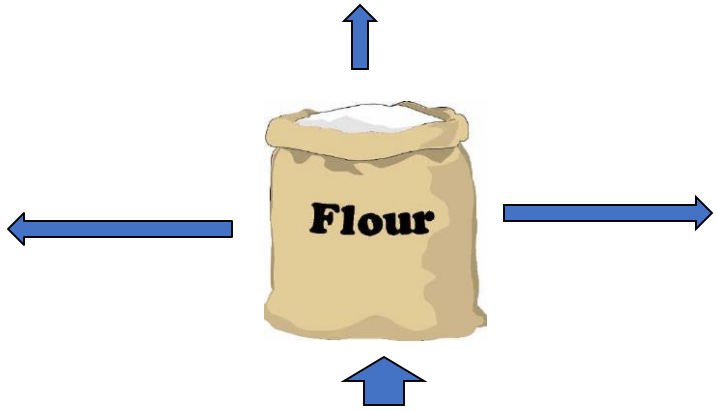
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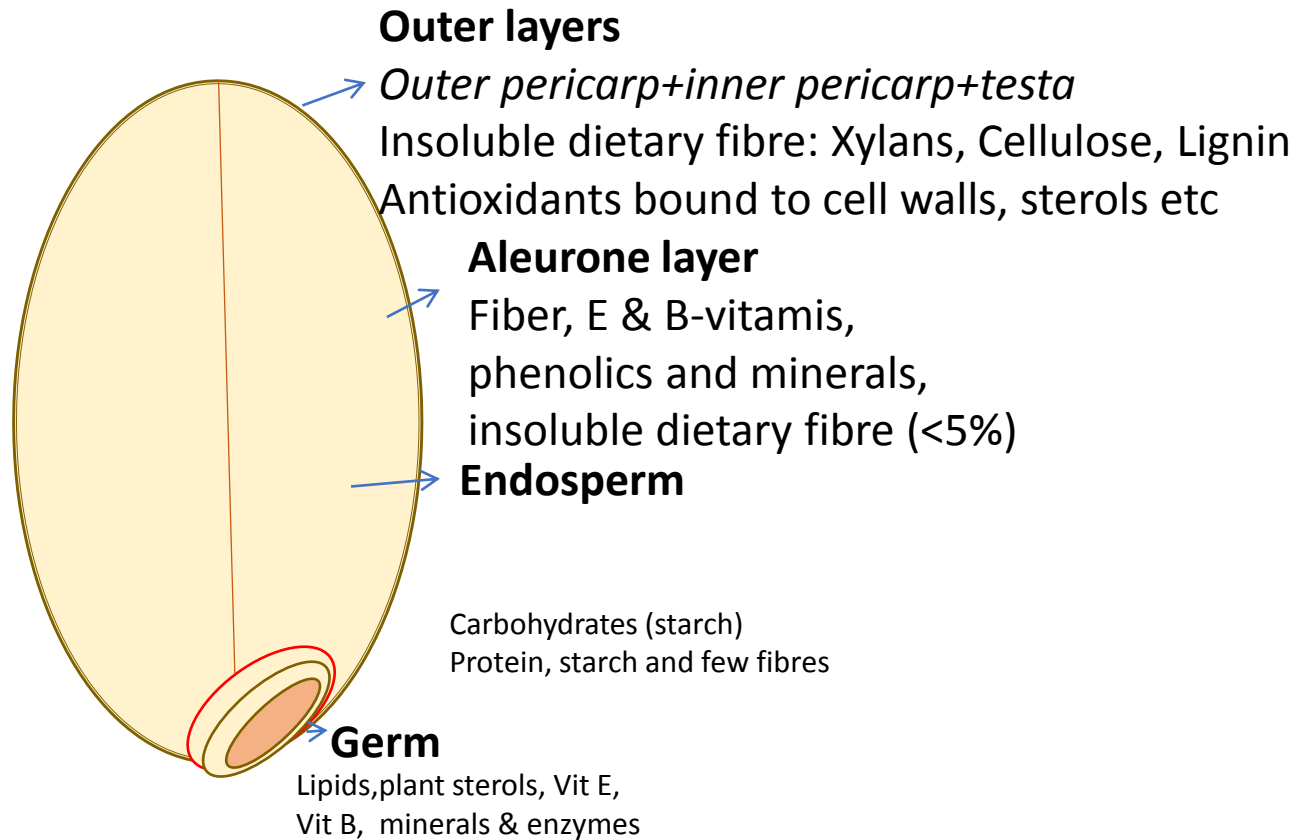
# Outline

- Wheat – an important crop
- Canadian western hard red spring (CWRS) wheat cultivars
- Wheat grain composition
  - Arabinoxylans
  - B-Glucans
- Enzymatic fingerprinting
  - HPAEC-PAD
  - PCA

# Wheat is consumed as diverse regional and ethnic products



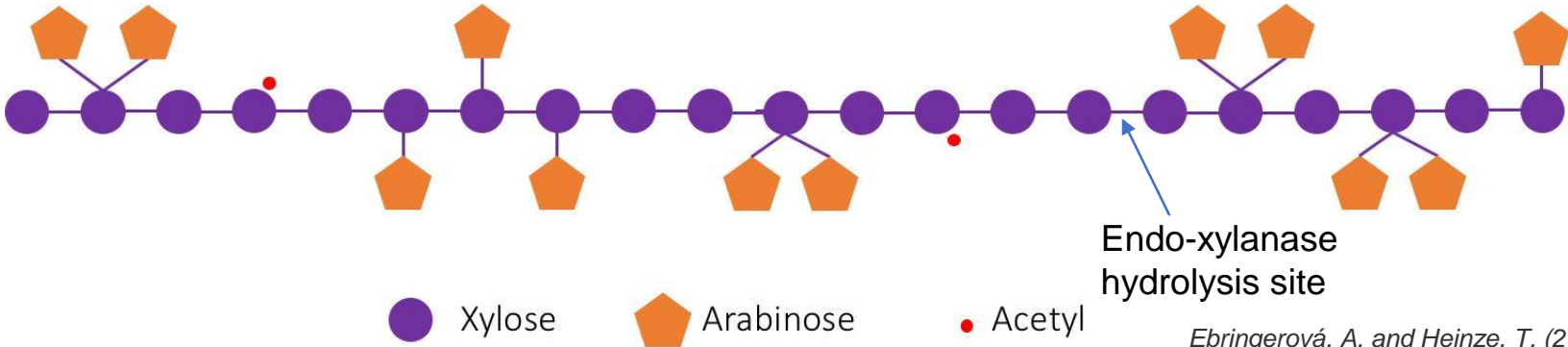
# Wheat grain - composition



# Composition of cell walls types in Wheat Grain (% dry weight)

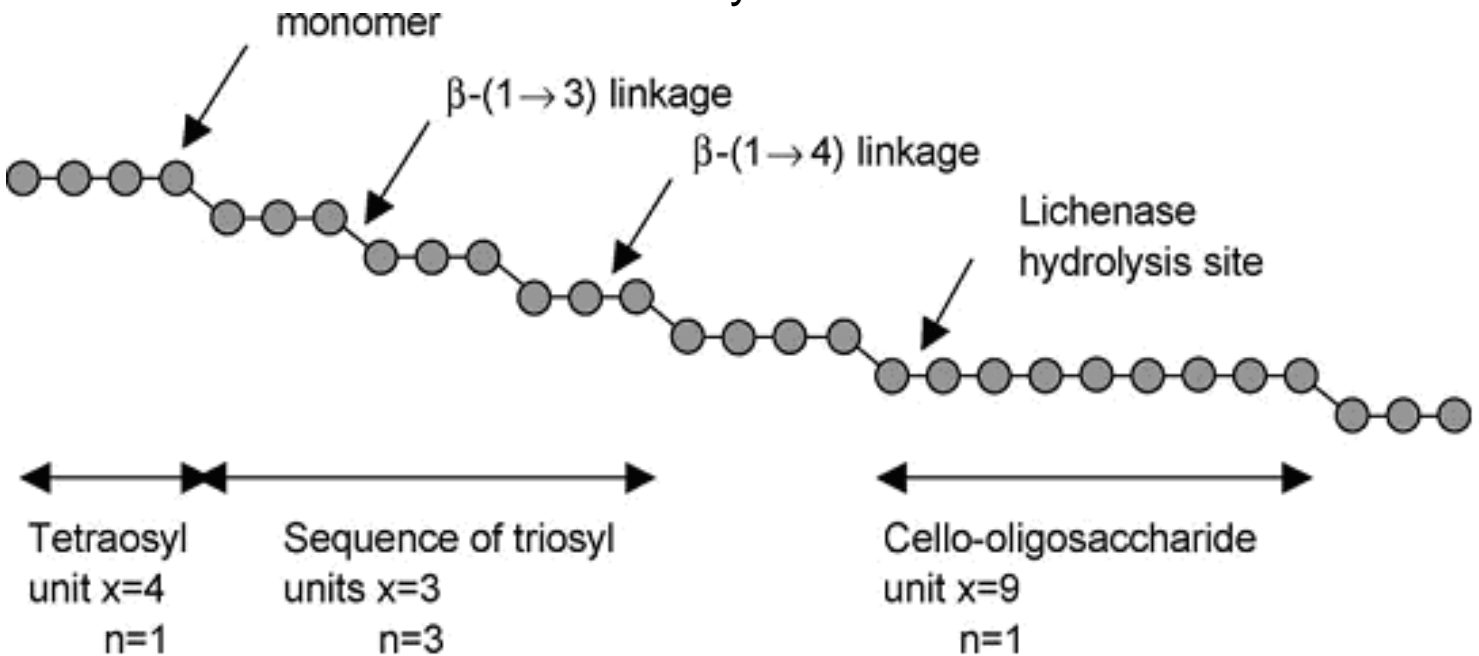
Origin of cell wall	Cellulose	Glucoman- mannan	B-glucan	Heteroxylan
Starchy endosperm	2	2	20	70
Aleurone	2	2	29	65
Bran (pericarp, seedcoat, aleurone)	29		6	64
Beeswing Bran (outer pericarp)	30			60

# Schematic representation of Arabinoxylan and $\beta$ -glucan in plant cell walls



*Ebringerová, A. and Heinze, T. (2000) Macromol. Rapid Commun., 21: 542–556*

## Arabinoxylan



## $\beta$ -glucan

*Susan M. et al., Carbohydrate Polymers. 2004, 57: 249-259*

# Research Question

*Is modern wheat nutritionally different from its predecessor wheat cultivars released in Canada??*

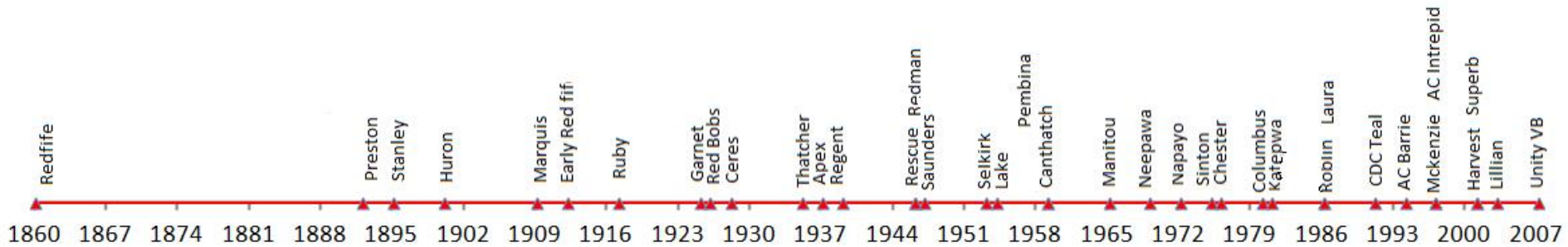
Analyzed Protein, Carbohydrates, Minerals and **Dietary Fiber** in historical and modern day wheat varieties in Canada

# Varieties used in Historical Wheat Trials

Year of registration	Number of Varieties
1860 – 1900	4
1901 – 1950	12
1951 – 1975	8
1976 – 2010	13
Total	37



# Experimental Study Plan

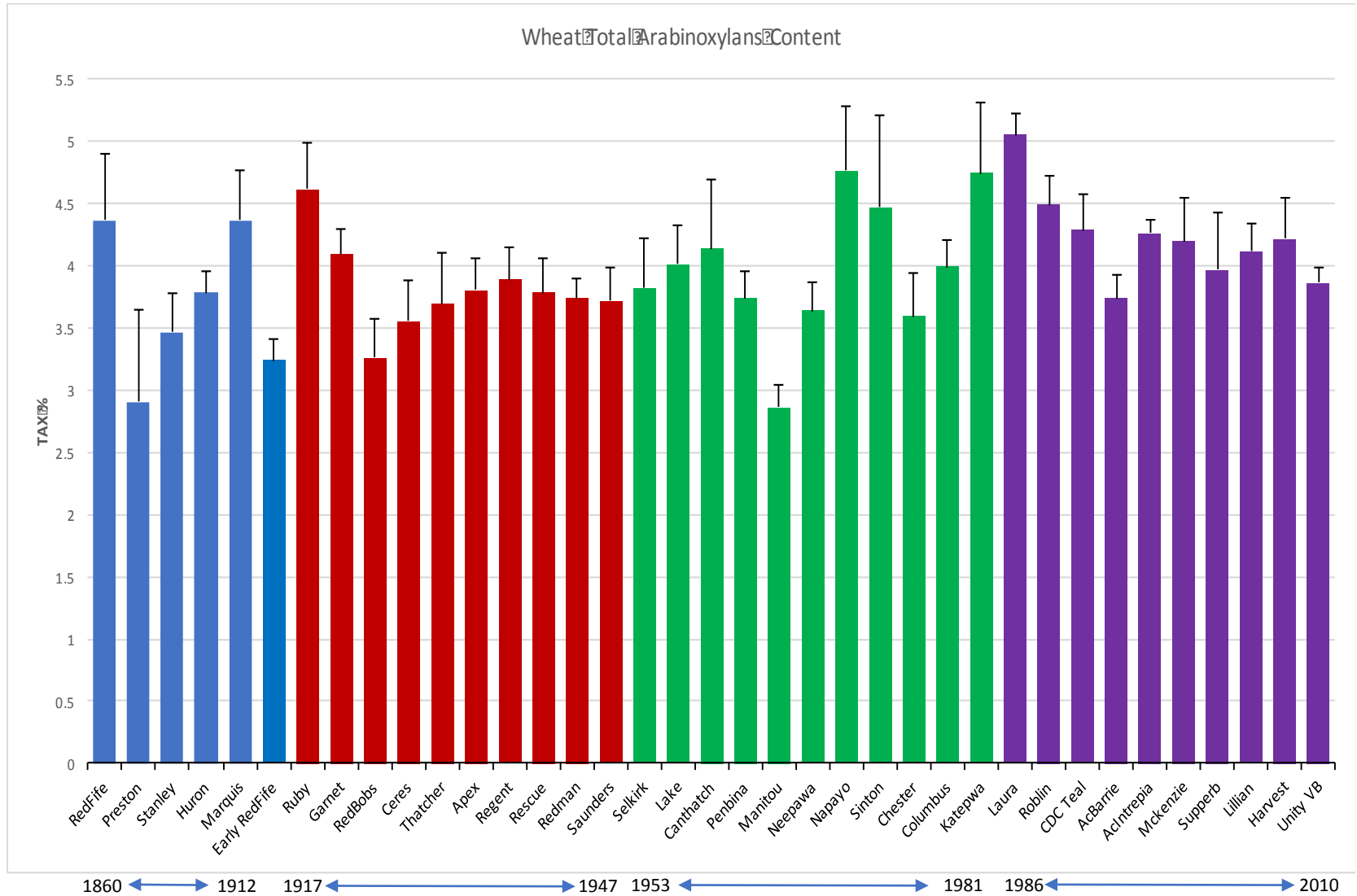


A	B	A	B
C	D	C	D

2013

2014

# Total Arabinoxylan Content in wheat cultivars



# Enzymatic fingerprinting using High Performance Anion Exchange Chromatography-Pulsed Amperometric Detection (HPAEC-PAD)

- Structural heterogeneity in genotypes
- Enzymes - endo-xylanase (AX) and lichenase (BG)
- Enzymes action- structure and Oligosaccharides patterns



Thermo Scientific Dionex ICS-3000

# Enzymatic hydrolysis products

## Arabinoxylans

- Xylose (X)
- Xylobiose (XX)
- Arabino-Xylo-Oligosaccharides (AXOS)
  - $XA^3X$
  - $XA^3XX$
  - $XA^{2+3}XX$
  - $XA^3A^3XX$
  - $XA^3XA^3XX$
  - $XA^3A^{2+3}XX$
  - $XA^3XA^{2+3}XX$
  - $XA^{2+3}A^{2+3}XX$

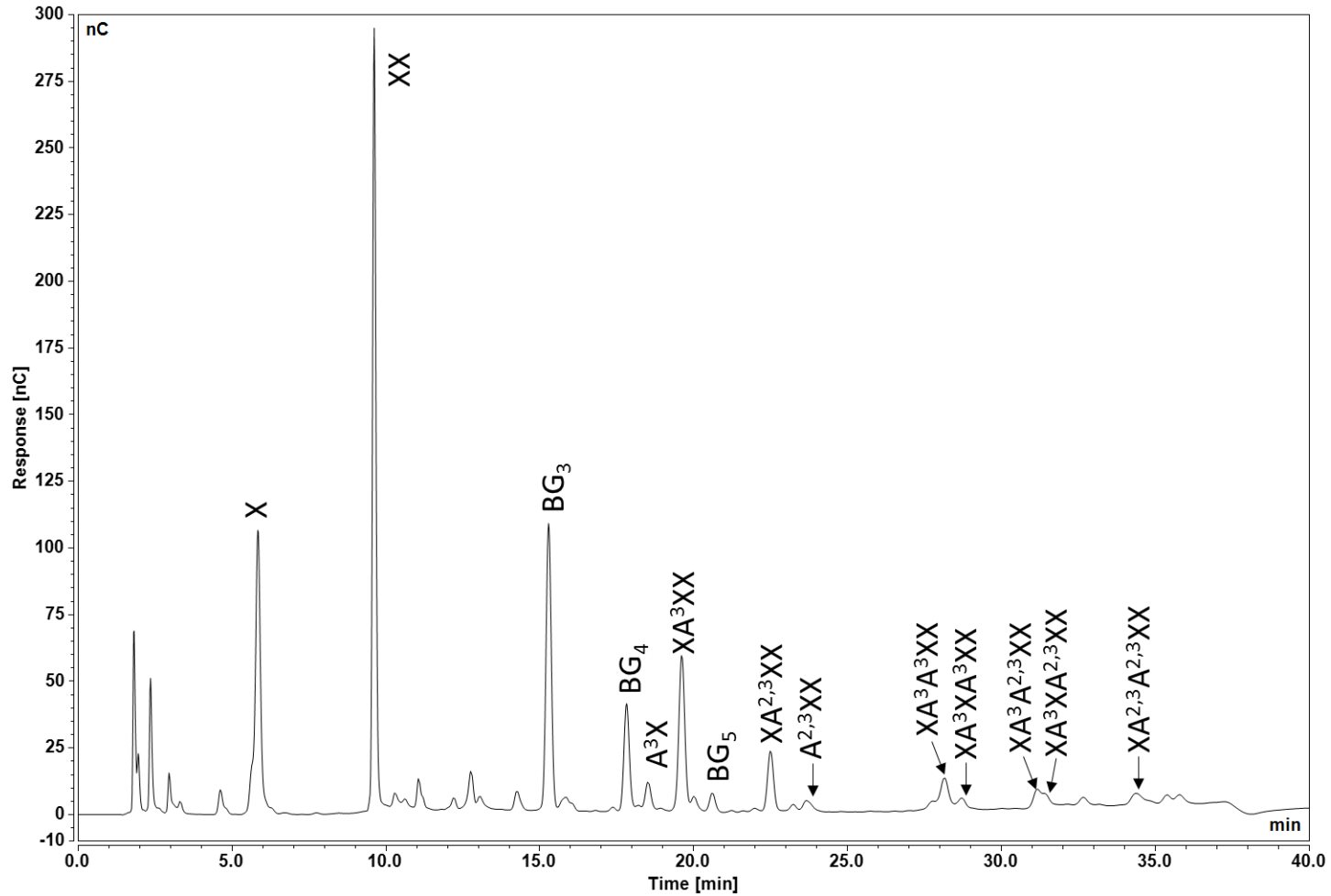
$A^3$ :  $\alpha$ -L-Araf-(1→3)- $\beta$ -D-Xylp

$A^{2+3}$ :  $\alpha$ -L-Araf-(1→2)-[ $\alpha$ -L-Araf-(1→3)]-  $\beta$ -D-Xylp

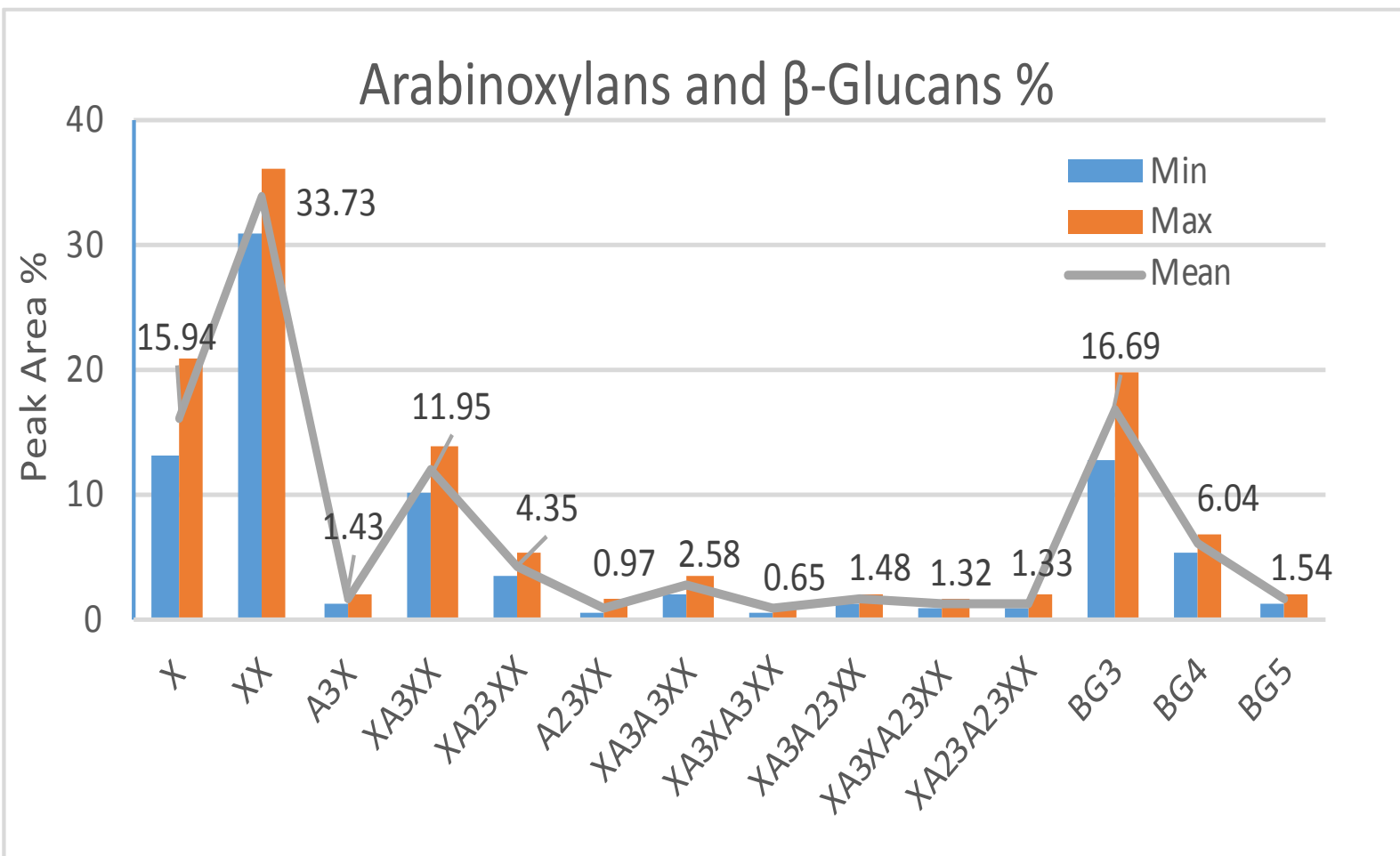
## $\beta$ -Glucans

- BG3 - 3-O- $\beta$ -cellobiosyl-d-glucose
- BG4 - 3-O- $\beta$ -cellotriosyl-d-glucose
- BG5 - 3-O- $\beta$ -cellotetraosyl-d-glucose

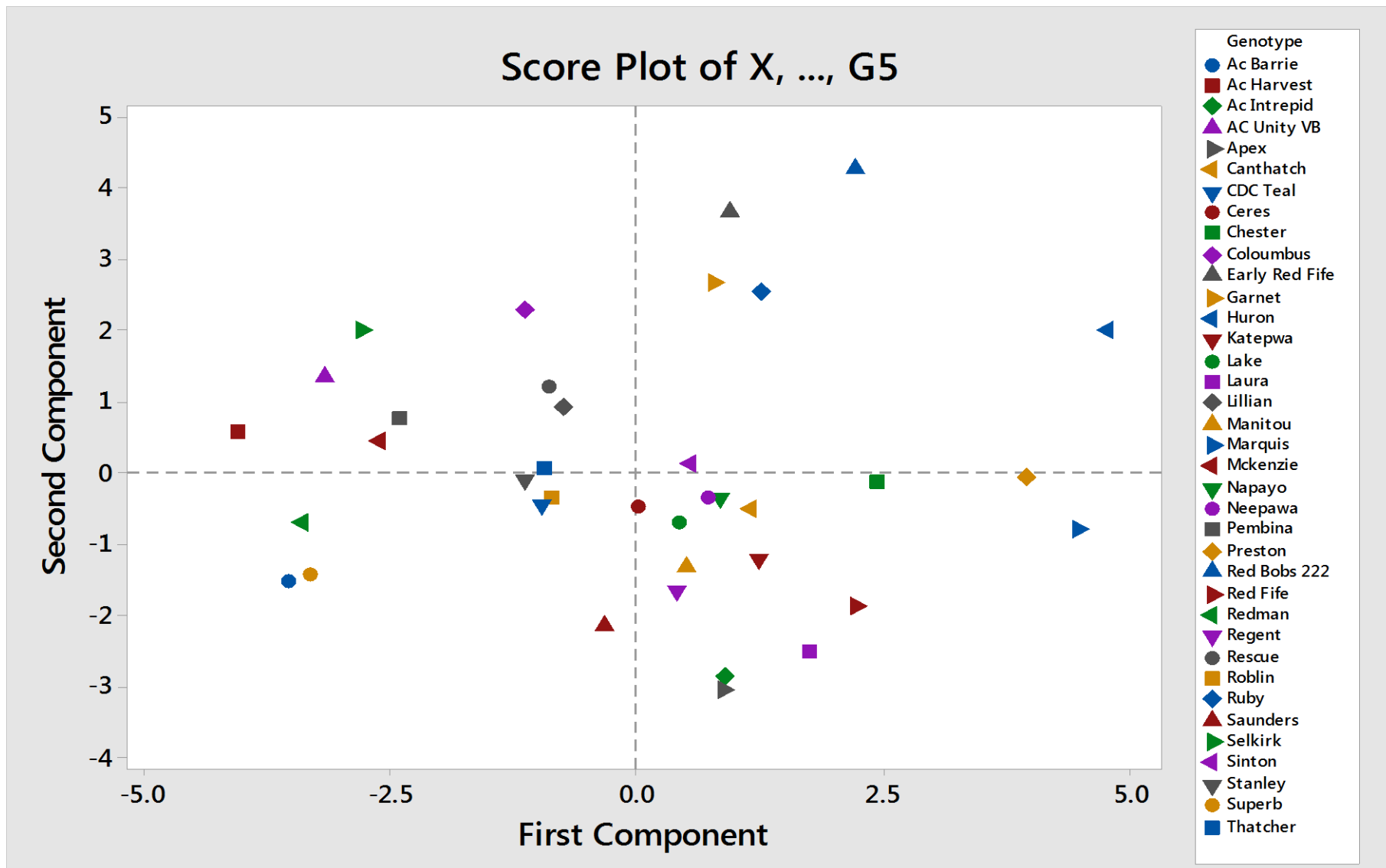
# Typical HPAEC profile of arabinoxylans and $\beta$ -glucans



# Arabinoxylan and $\beta$ -Glucan fractions in 37 wheat varieties

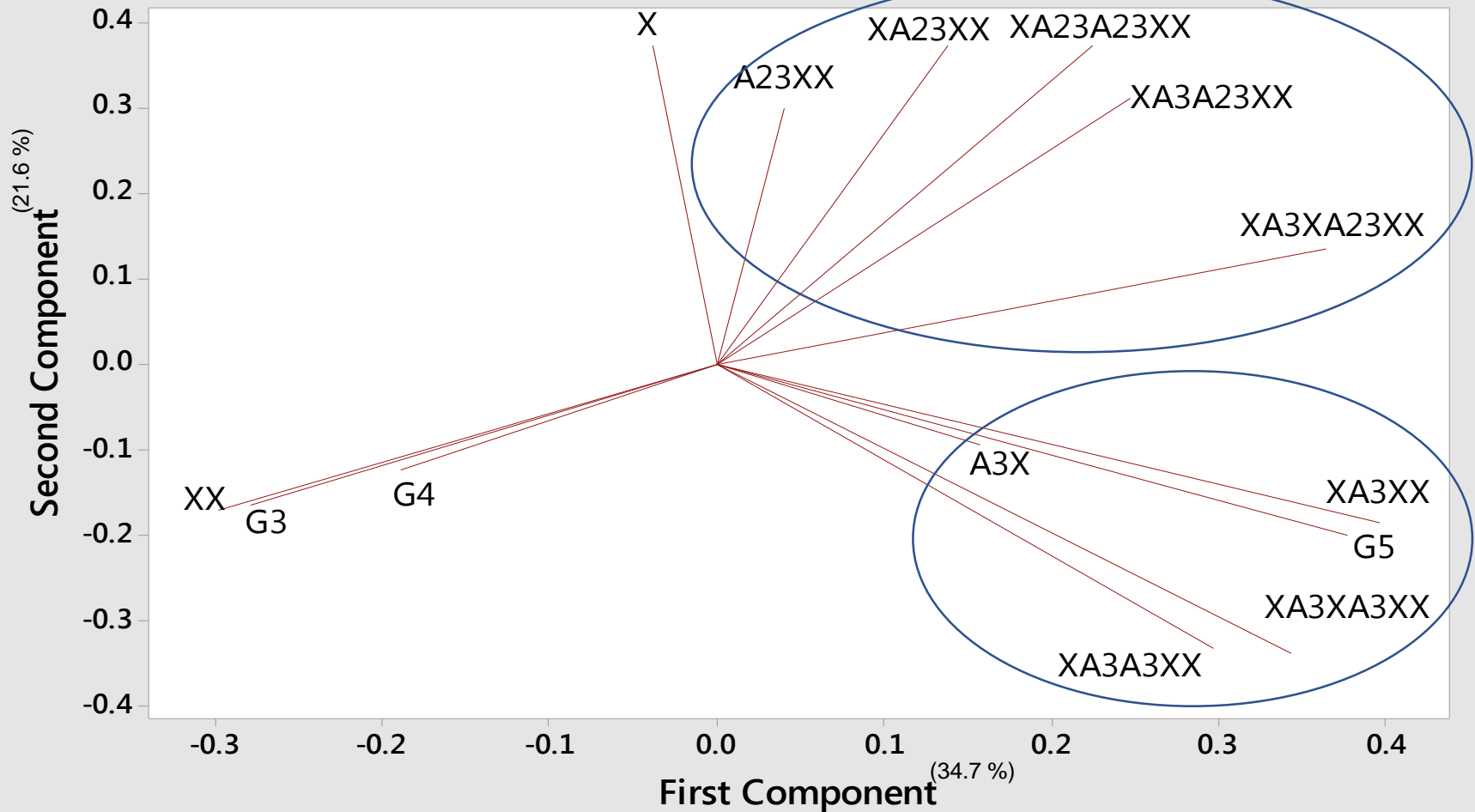


# PCA of Arabinoxylan and $\beta$ -Glucans hydrolysis fragments does not reveal a trend over time



# PCA of Arabinoxylan and $\beta$ -Glucans hydrolysis fragments show similarity in structure

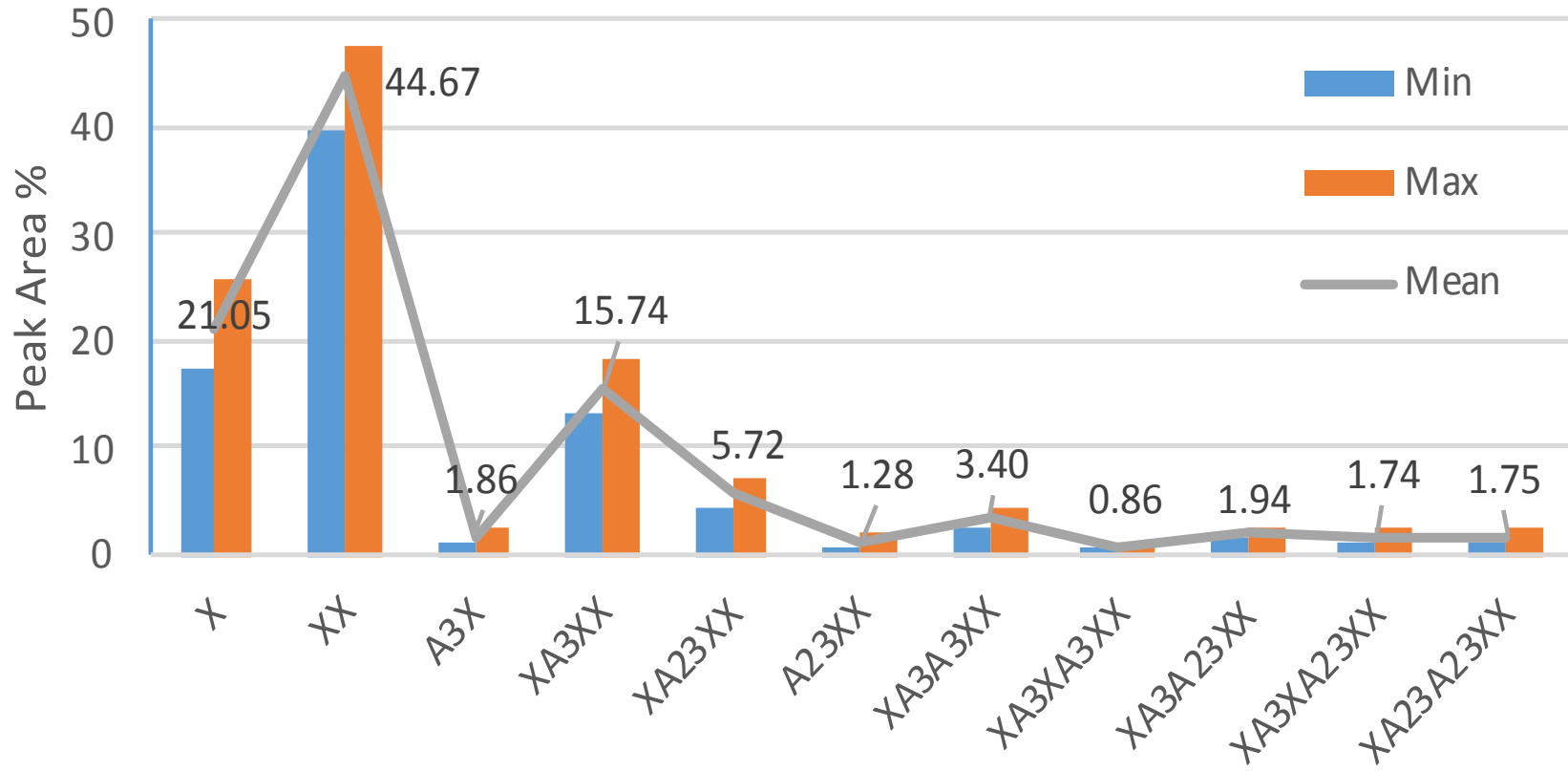
## Loading Plot of X, ..., G5





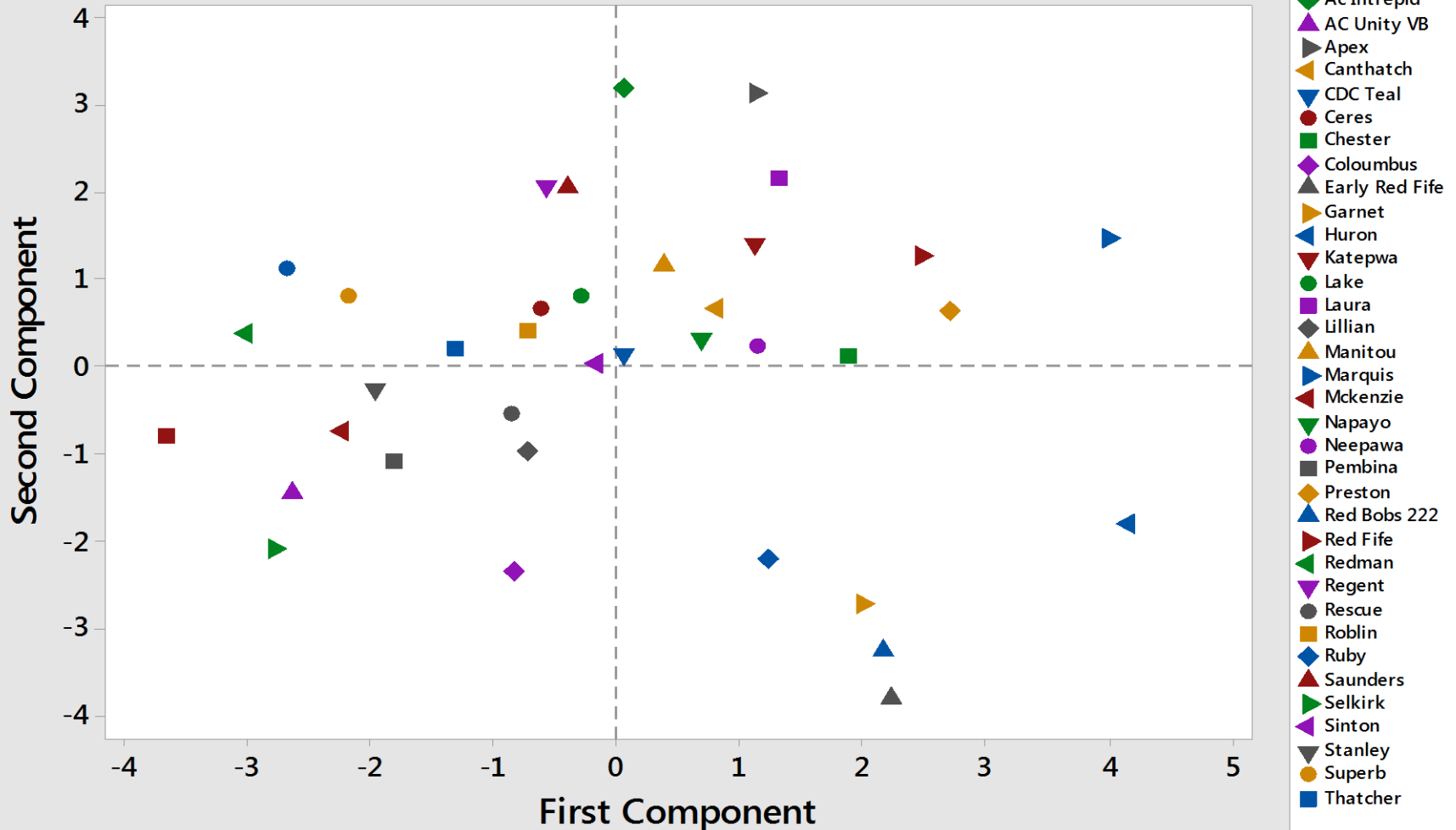
# Arabinoxylan fractions in 37 wheat varieties

## Arabinoxylans components %



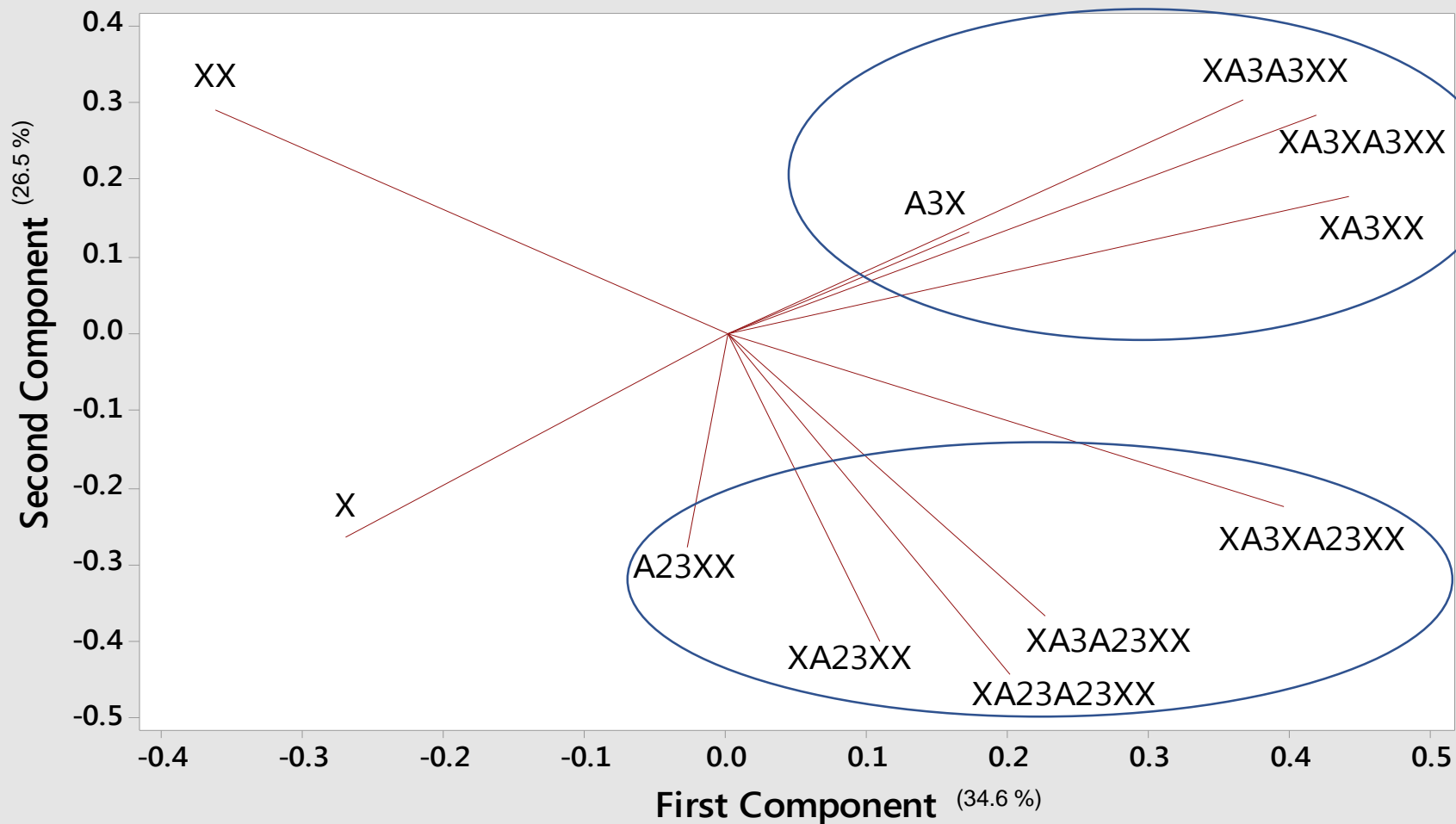
# PCA of Arabinoxylan hydrolysis fragments does not reveal a trend over time

Score Plot of X, ..., XA23A23XX

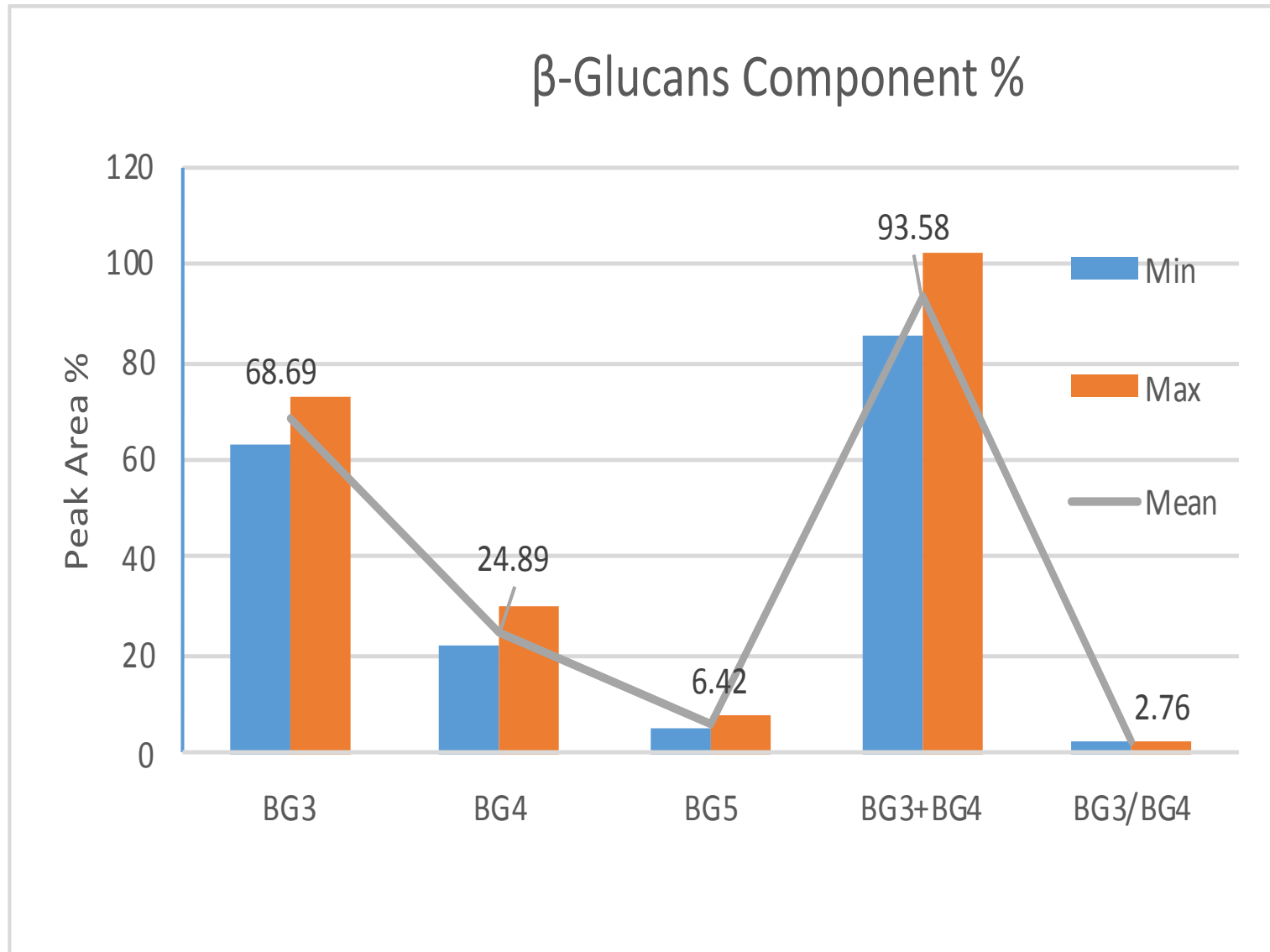


# PCA of Arabinoxylan hydrolysis fragments show similarity in structure

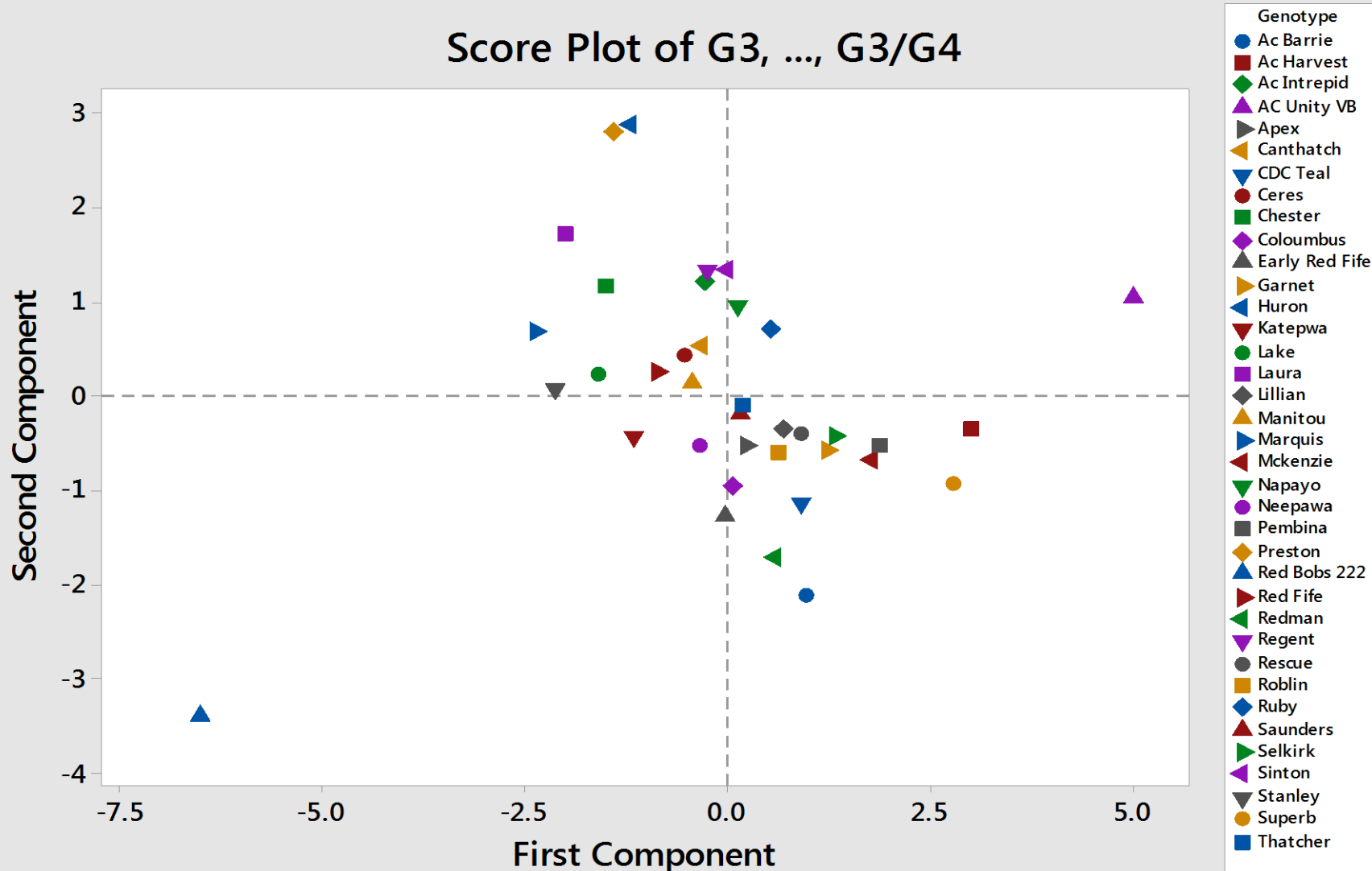
## Loading Plot of X, ..., XA23A23XX



# $\beta$ -Glucan fractions in 37 wheat varieties

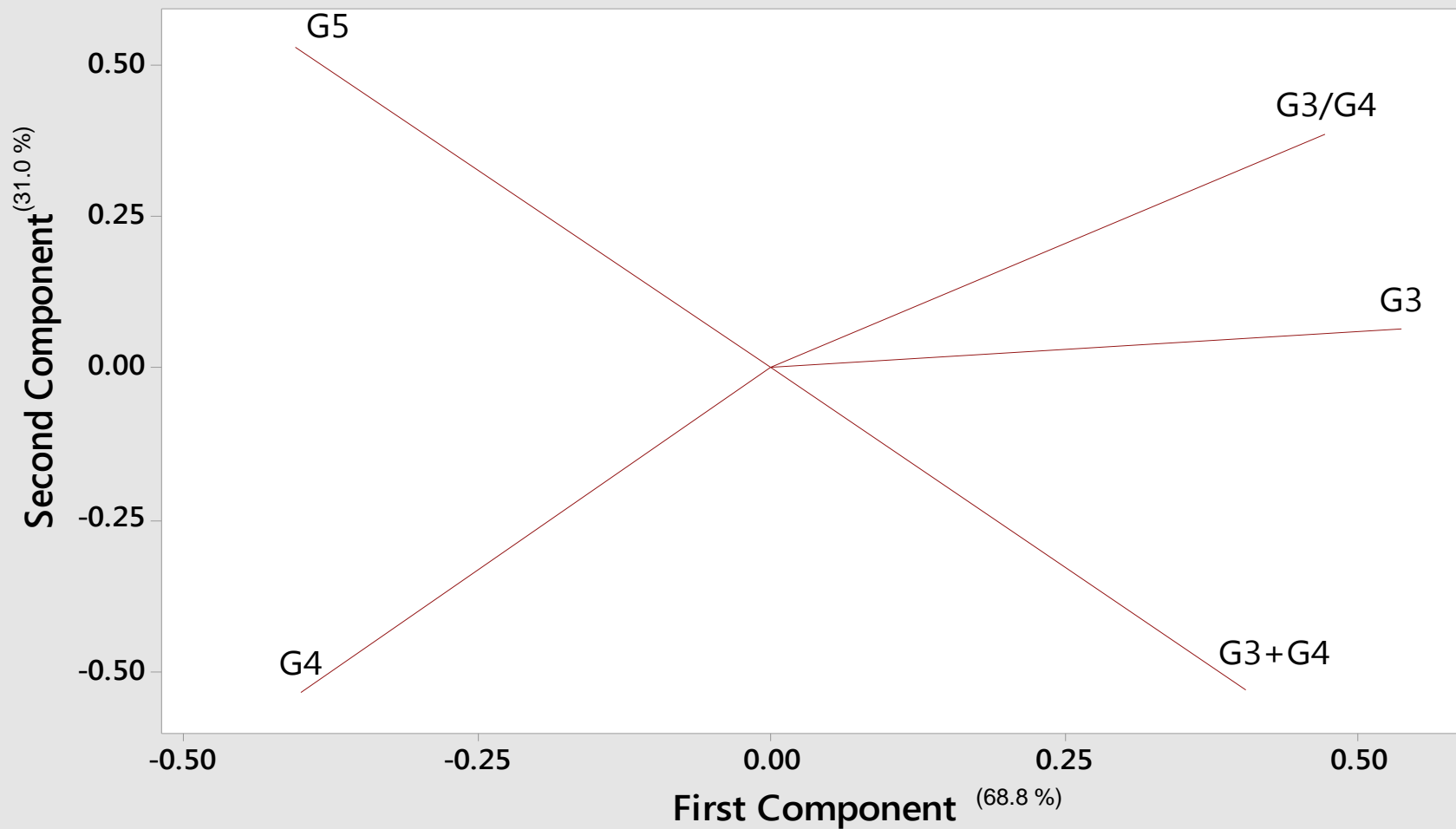


# PCA of $\beta$ -Glucans hydrolysis fragments does not reveal a trend over time



# PCA of $\beta$ -Glucans hydrolysis fragments show similarity in structure

## Loading Plot of G3, ..., G3/G4



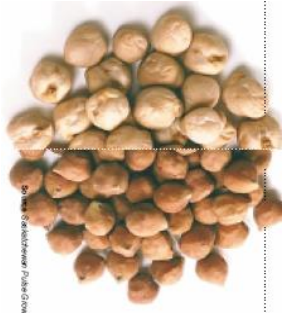
# Conclusions

- Optimized a method to finger print wheat arabinoxylan and  $\beta$ -Glucans
- No systematic change in arabinoxylan concentration over time
- No systematic change in arabinoxylan and  $\beta$ -glucan structures over time

# Acknowledgements



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