

Influences of HMW-GS composition and rye translocations on dough mixing properties and cookie baking quality of soft winter wheat

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INTRODUCTION

The sugar-snap cookie baking test is the most commonly performed baking test in the evaluation of soft wheat end-use quality. Soft wheat varieties with good cookie baking potential are believed to be suitable for many other soft wheat products. The significance of high-molecular-weight glutenin subunits (HMW-GSs) and rye translocations, and their associations with gluten strength, are well understood for hard wheat in making bread, but remain poorly understood for soft wheat in making cookies.

AIM

The influences of HMW-GSs and rye translocations on dough mixing properties and cookie-baking quality were investigated using 50 selected U.S. eastern soft winter (ESW) wheat varieties carrying fourteen predominant HMW-GS profiles accounting for 80% of the recently developed ESW wheat varieties.

MATERIALS AND METHODS

Materials

- Experiment set: 50 ESW genotypes carrying 14 predominant HMW-GS profiles
- Validation set: 77 ESW genotypes

Methods

- Grain and flour characteristics:
 - Grain: protein content & kernel hardness
 - Flour: protein content, lactic acid and sodium carbonate solvent retention capacities (SRCs) & mixograph
- Preparation of sugar-snap cookies: AACCI Method 10-52.02

RESULTS AND DISCUSSION

Influence of HMW-GS composition on dough mixing properties

The midline peak times (MPTs) of ESW wheat genotypes were ranked in the order of subunits 1>2* at the *Glu-A1* locus, 7*+8=13+16>7+8=7+9 at the *Glu-B1* locus and 5+10>2+12>2+12₁=2+10 at the *Glu-D1* locus. (Figure 1)

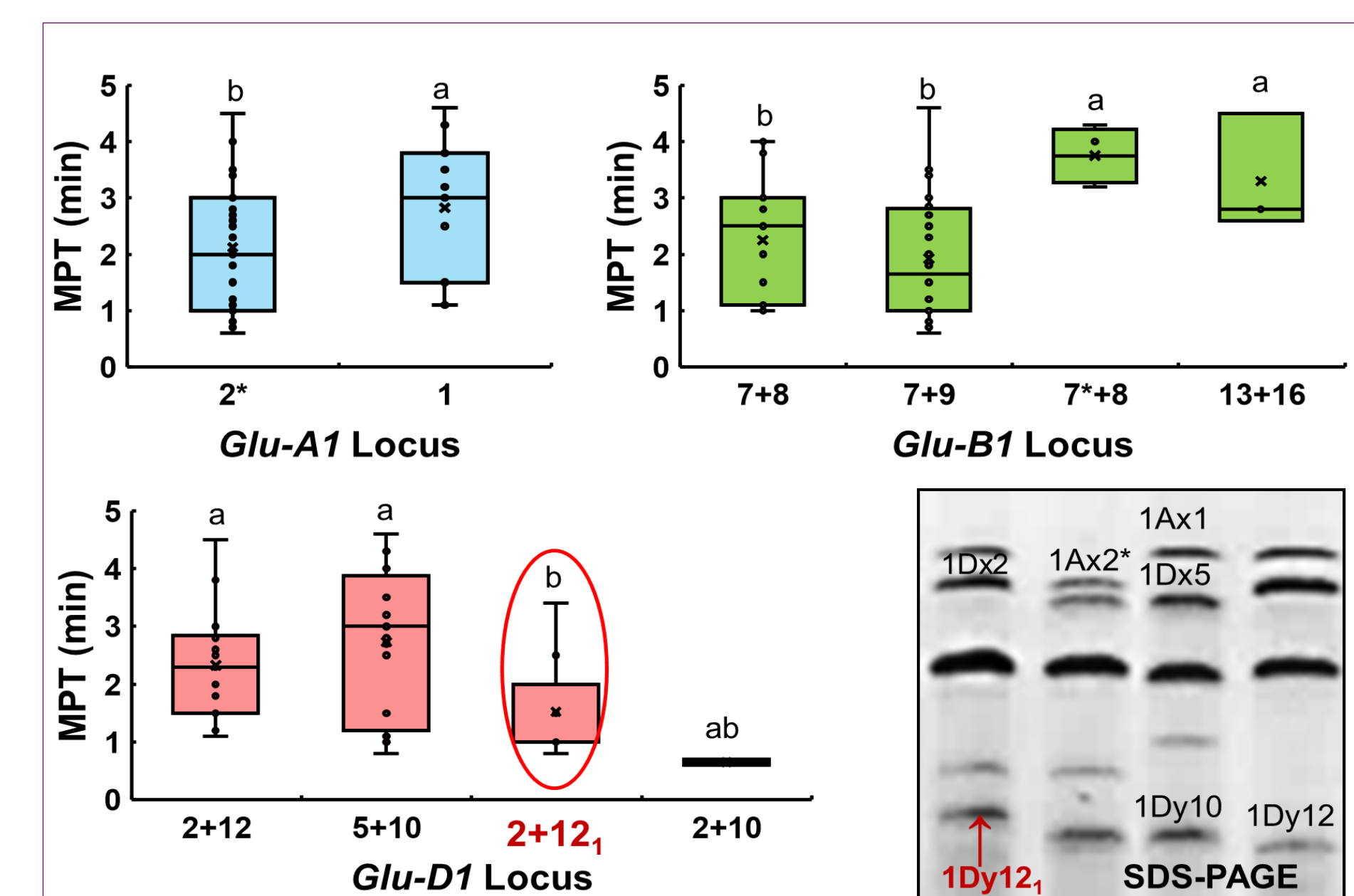


Figure 1. Influences of individual HMW-GSs on MPTs

Influence of HMW-GS composition on cookie diameter

Only HMW-GSs at the *Glu-D1* locus exhibited a significant influence on cookie diameter. Individual subunits at the *Glu-D1* locus were ranked 2+12₁>2+10=2+12=5+10 (Figure 2), indicating that subunits 2+12₁ are favorable for cookie baking. The result was validated using 77 ESW wheat varieties (Figure 2)

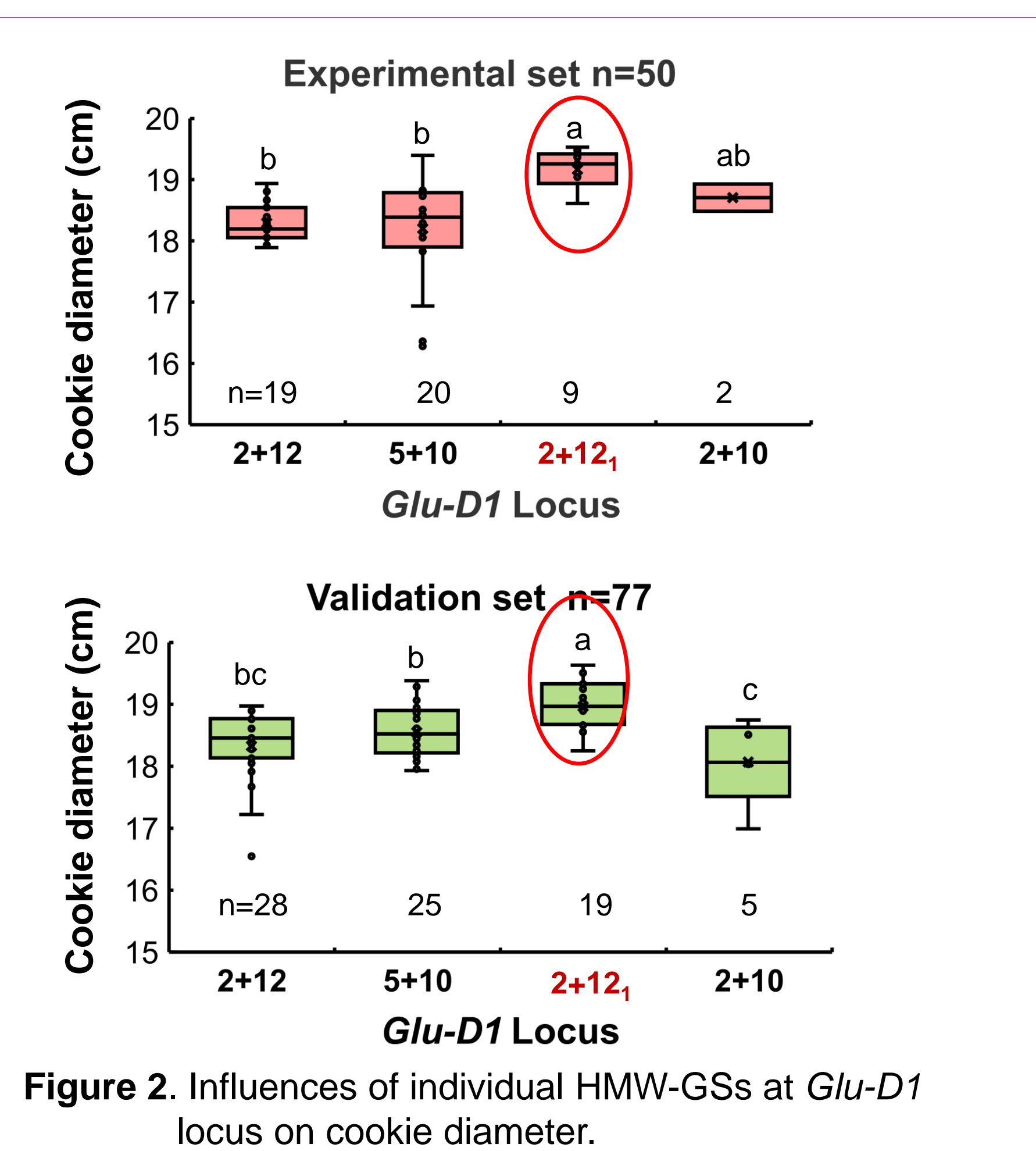


Figure 2. Influences of individual HMW-GSs at *Glu-D1* locus on cookie diameter.

Table 1. Influence of rye translocation on protein characteristics and cookie diameter

HMW-GS profile / Rye translocation type	Flour protein (%)	MPT (min)	Cookie diameter (cm)
All HMW-GS profiles			
Absence (n=38)	9.0a	2.4a	18.5a
1AL/1RS (n=6)	9.5a	1.7a	18.0a
1BL/1RS (n=6)	8.9a	1.9a	18.6a
2*, 7+9, 2+12			
Absence (n=5)	8.7b	2.1a	18.6a
1AL/1RS (n=3)	9.7a	1.7a	18.0b
1BL/1RS (n=3)	9.2ab	2.0a	18.2b
2*, 7+8/7+9, 5+10			
Absence (n=5)	9.2a	3.3a	18.1a
1AL/1RS (n=3)	9.3ab	1.6b	18.1a
1BL/1RS (n=3)	8.5b	1.8b	19.0a

Values within each HMW-GS profile in the same column followed by the same letter are not significantly different at the 0.05 probability level.

Influence of rye translocation on protein characteristics & cookie diameter

The influence of wheat-rye translocations on protein characteristics and cookie diameter was dependent on HMW-GS profile (Table 1).

Influence of HMW-GS profile on protein characteristics & cookie diameter

ESW wheat varieties possessing different HMW-GS profiles exhibited large variations in protein characteristics and cookie diameter (Table 2).

Table 2. Influence of HMW-GS profile on protein characteristics and cookie diameter

<i>Glu-1</i> Loci			Number of varieties	Flour protein (%)	MPT (min)	Cookie diameter (cm)
A1	B1	D1				
2*	7+9	2+12 ₁	3	8.2e	1.7cd	19.3a
2*	7+8	2+12 ₁	4	8.4de	1.1de	19.1ab
1	7+8	2+12 ₁	2	8.5cde	2.0bc	19.0ab
1	7*+8	5+10	2	8.5cde	3.8a	18.7abc
2*	7+9	2+10	2	8.8bcde	0.7d	18.7abc
2*	7+9	2+12	11	9.1bcde	2.0bcd	18.3abcd
2*	7+9	5+10	6	9.1bcde	1.7cd	18.5abcd
2*	7+8	2+12	3	9.2bcde	2.0cd	18.4abcd
1	7+8	2+12	2	9.7b	3.4a	18.2bcd
2*	13+16	2+12	3	9.5bc	3.3ab	18.2bcd
2*	7+8	5+10	5	9.0bc	3.4a	18.2bcd
1	7+8	5+10	3	8.6bcde	1.6cd	18.0cd
1	7+9	5+10	2	11.1a	4.1a	18.0cd
2*	7*+8	5+10	2	9.1bc	3.8a	17.5d

Values in the same column followed by the same letter are not significantly different at the 0.05 probability level.

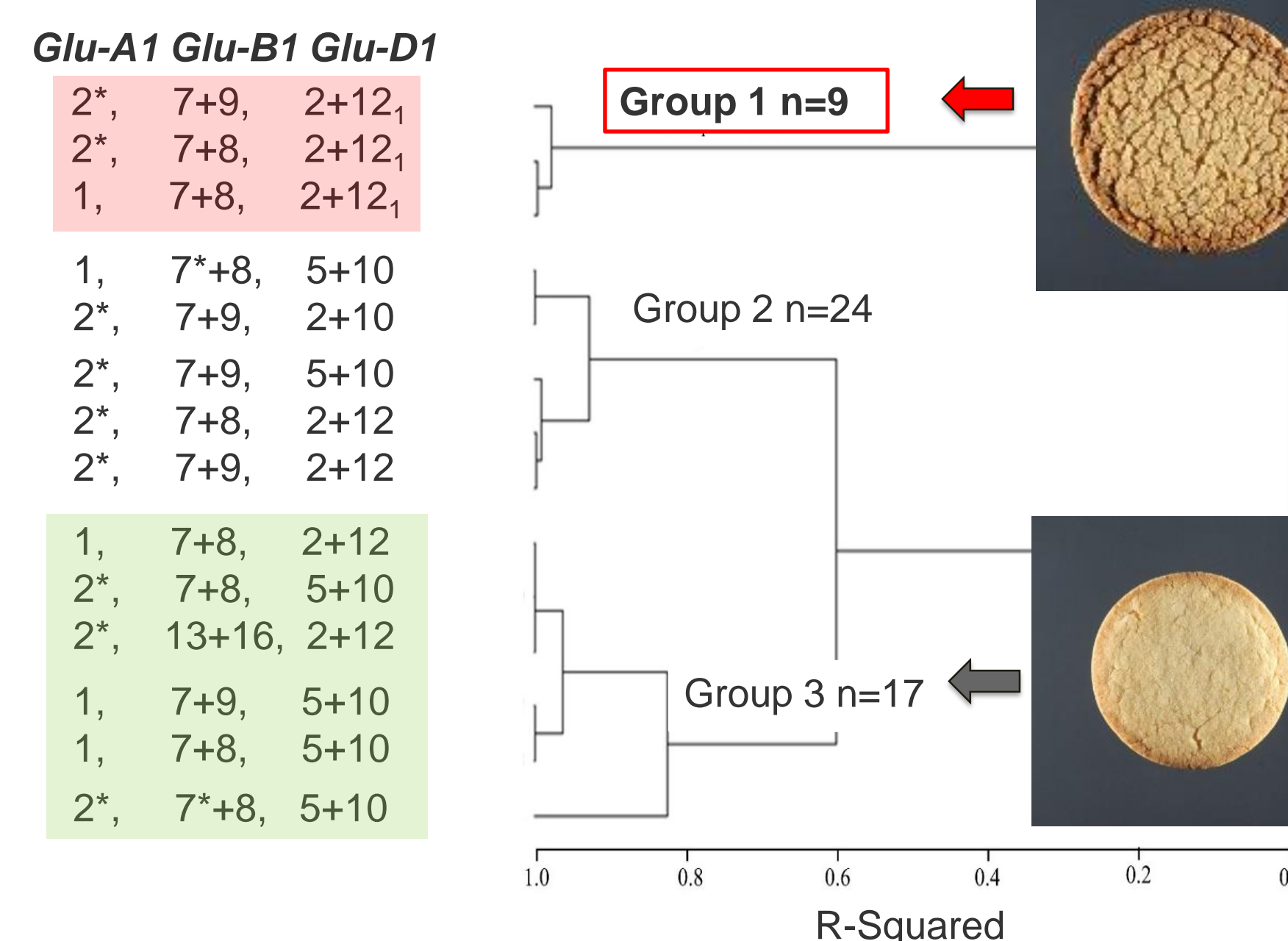


Figure 3. Hierarchical cluster analysis of 14 predominant HMW-GS profiles of U.S. eastern soft winter wheat varieties based on averaged cookie diameter.

Cluster analysis of ESW genotypes based on cookie diameter

Nine ESW wheat varieties (group 1, producing cookies of the largest diameter) exhibited lower kernel hardness, and lower sodium carbonate SRC and flour protein content than those in groups 2 & 3 (Figures 3 & 4). Three HMW-GS profiles carrying subunits 2+12₁ were identified to be desirable for cookie production (Figure 3).

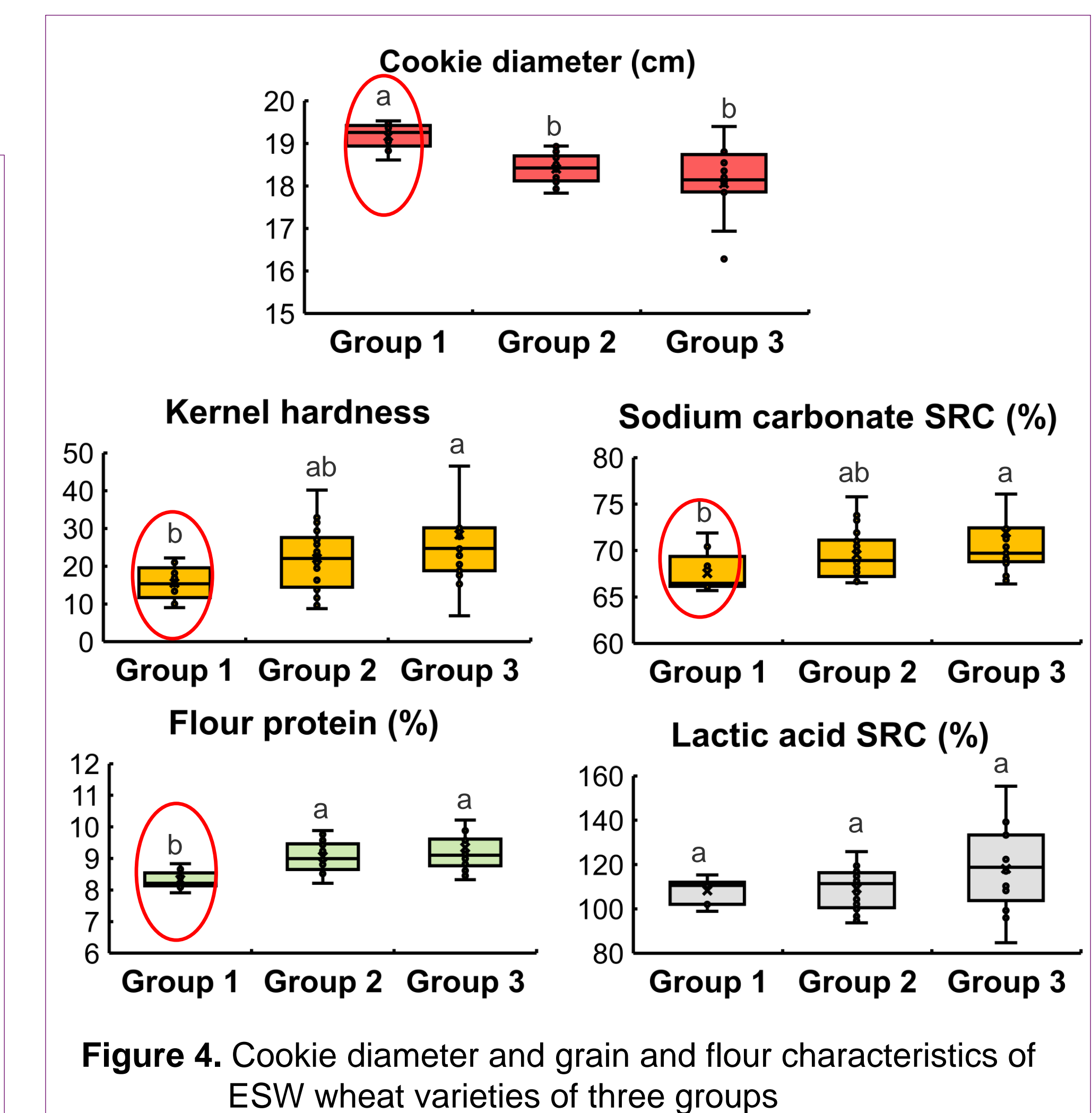


Figure 4. Cookie diameter and grain and flour characteristics of ESW wheat varieties of three groups

CONCLUSIONS

- The *Glu-D1* locus exhibited a greater influence on cookie diameter than the *Glu-A1* and *Glu-B1* loci.
- Wheat varieties carrying subunits 2+12₁ produced cookies of larger diameter than those carrying other subunits.
- The effect of rye translocations on grain and flour characteristics and cookie diameter was dependent on HMW-GS profile.
- Three HMW-GS profiles containing subunits 2+12₁ were desirable for cookie production.

BIBLIOGRAPHY

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