

Association Mapping of Seed Antioxidant Content and Seedcoat Colors in USDA Cowpea Core Collection Using SNPs

Jun Qin, Ainong Shi, Haizheng Xiong, Beiquan Mou, Dennis Motes, Yuejin Weng, Wei Yang (University of Arkansas)
J. Creighton Miller Jr., Douglas Scheuring, and Ndambe Nzaramba (Texas A&M)
(Email contact: ashi@uark.edu)



OBJECTIVE

- Cowpea (*Vigna unguiculata* L. Walp.) is an important legume, and the antioxidant content in cowpea seeds has been recognized as a health-promoting compound for humans.
- To analyze the population structure of cowpea collections using single nucleotide polymorphism (SNP).
- To identify SNP markers associated with the seed antioxidant content in cowpea.

MATERIALS AND METHODS

- 369 cowpea accessions from the core collection, originally collected from 47 countries.
- Phenotypic data were analyzed using Microsoft (MS) Excel 2013 and JMP Genomics 7 software.
- The STRUCTURE and MEGA software programs were used to analyze the population structure and genetic diversity.
- Single marker regression (SMR), general linear model (GLM), and mixed linear model (MLM) in Tassel were used for association analysis between the SNPs and the phenotypic data of the seed antioxidant content and seed coat color.

RESULTS

Population Structure and Genetic Diversity

There was wide genetic variation in seed antioxidant content and seed coat color in the cowpea population (Fig1).

There were three clusters in the 369 entries based on SNP data (Fig.2).

Phenotype Correlation Analysis

The ANOVA and T-test showed that seed antioxidant content differed depending on seed coat colors; the red and black colored seeds contained higher antioxidant content than brown, blue and white/cream seeds. The white/cream seeds had significantly lower content than the other colored seeds.

Association Analysis and SNP Markers Identification

Different SNP markers were found to be associated with seed antioxidant content and seed coat color with different models. The two SNP markers, Scaffold7139_14363 and scaffold29110_4657 were strongly associated with antioxidant content, and three SNP markers, C35063613_1497, scaffold81493_886, and scaffold84620_6785, were strongly associated with seed coat color across three models (Table 1).

The SNP markers identified in this study could potentially be used in marker-assisted breeding to accelerate genetic improvement of cowpea for higher seed antioxidant content.

Fig. 1 The distributions of antioxidant content in cowpea seeds based on seed coat color: all color, black, blue, brown, red, tan, and white, respectively.

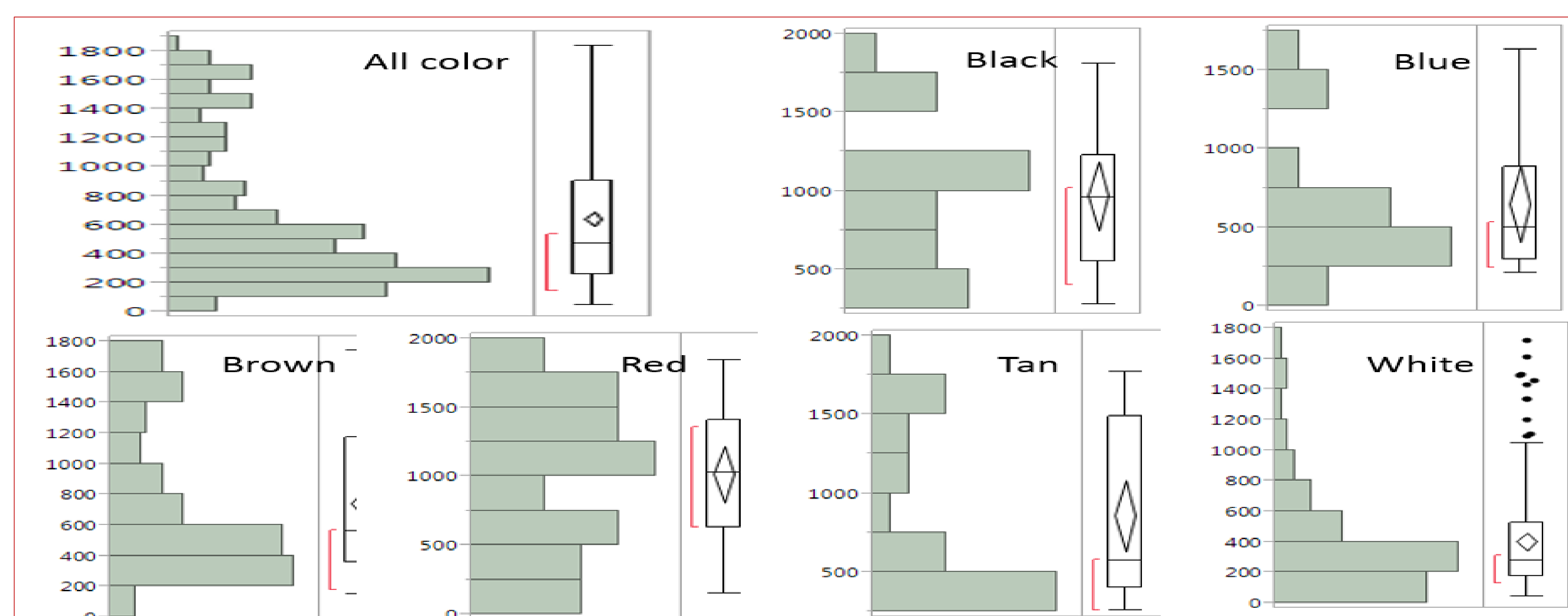


Fig.2 Model-based populations in the cowpea association panel of 369 cowpea accessions of core collection: The distribution of the accessions to different populations is indicated by the color code (Q1: red, Q2: green, Q3: blue), consistent in the figure A, B and C.

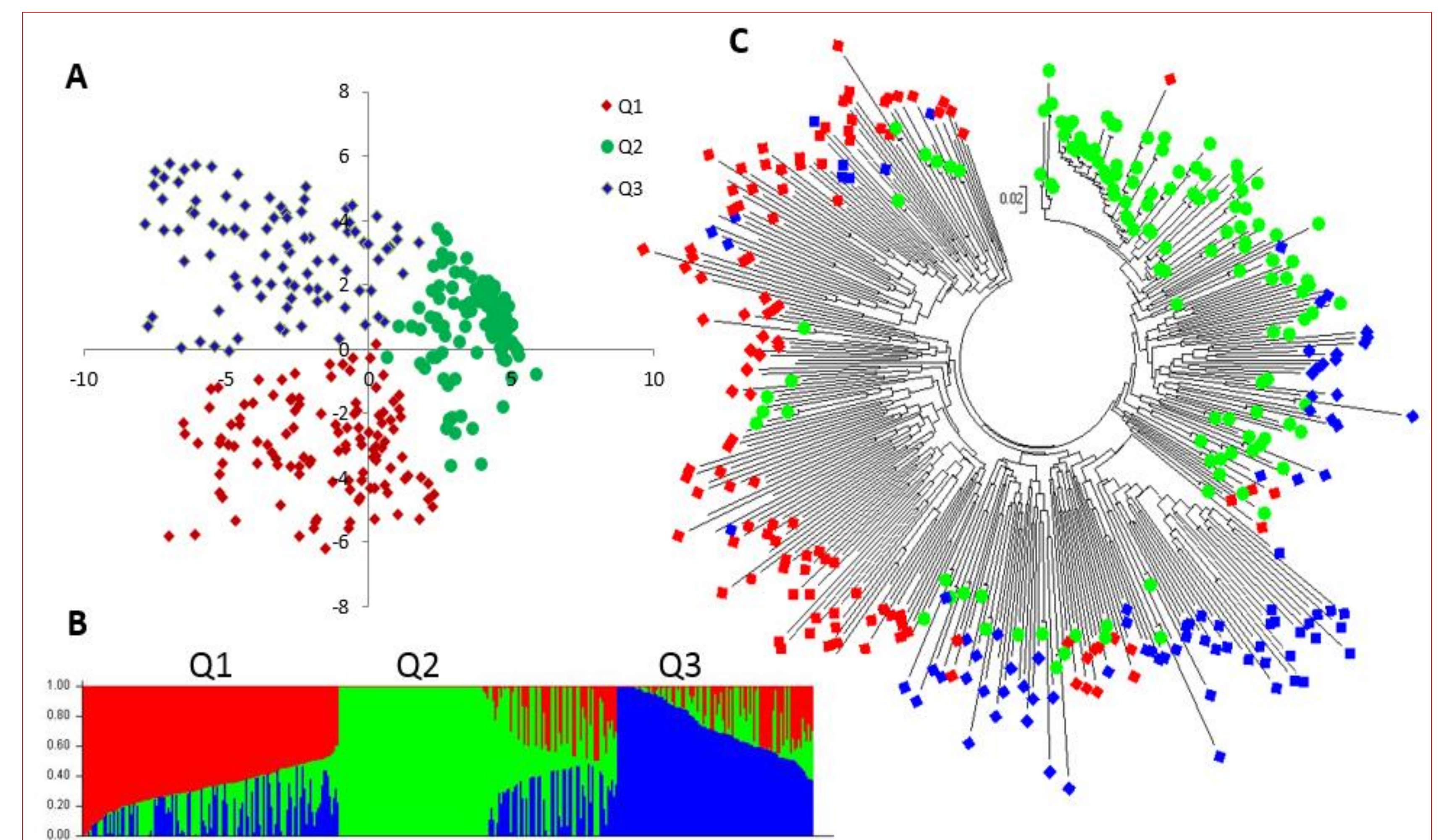


Table 1. SNP markers associated with seed antioxidant and seed coat colors using three statistical models, SMR, GLM (Q), and MLM (Q+K).

SNP marker	SMR (LOD)	GLM (LOD)	MLM (LOD)	Trait
Scaffold7139_14363	3.75	5.08	2.37	Antioxidant
Scaffold29110_4657	4.68	4.57	2.30	Antioxidant
Scaffold42008_191	2.98	2.89	2.56	Antioxidant
C35082838_2258	1.62	3.09	2.28	Antioxidant
C35063613_1497	8.71	6.66	3.85	Red
Scaffold81493_886	6.49	3.75	3.07	Red
Scaffold88685_3135	7.02	3.26	4.04	Red
Scaffold42008_191	3.97	2.14	0.38	Red
C35063613_1497	11.96	9.22	3.12	Black
Scaffold42008_191	4.18	2.12	0.07	black
C35063613_1497	10.85	7.24	3.92	Red+Black
Scaffold81493_886	10.20	5.90	5.10	Red+Black
Scaffold84620_6785	7.29	3.32	2.51	Red+Black
Scaffold42008_191	7.59	2.77	1.02	Red+Black
Scaffold81493_886	34.78	24.31	15.09	Colored
Scaffold40268_5600	8.27	3.58	2.70	Colored
C35082838_2258	7.51	2.01	1.86	Colored

ACKNOWLEDGMENTS

This work was supported by USDA-ARS GRIN GERMLASM EVALUATION PROPOSAL for National Plant Germplasm System (NPGS) by Crop Germplasm Committee (CGC) with Project Number: 6046-21000-011-15. Cowpea germplasm accessions were provide by USDA-ARS at GRIFFIN, GA Station. The cowpea_Genome_0.03.fa (6,750 scaffolds or contigs) (<http://harvest-blast.org/>) was kindly provided by Dr. Timothy J. Close at University of California Riverside, CA, USA.