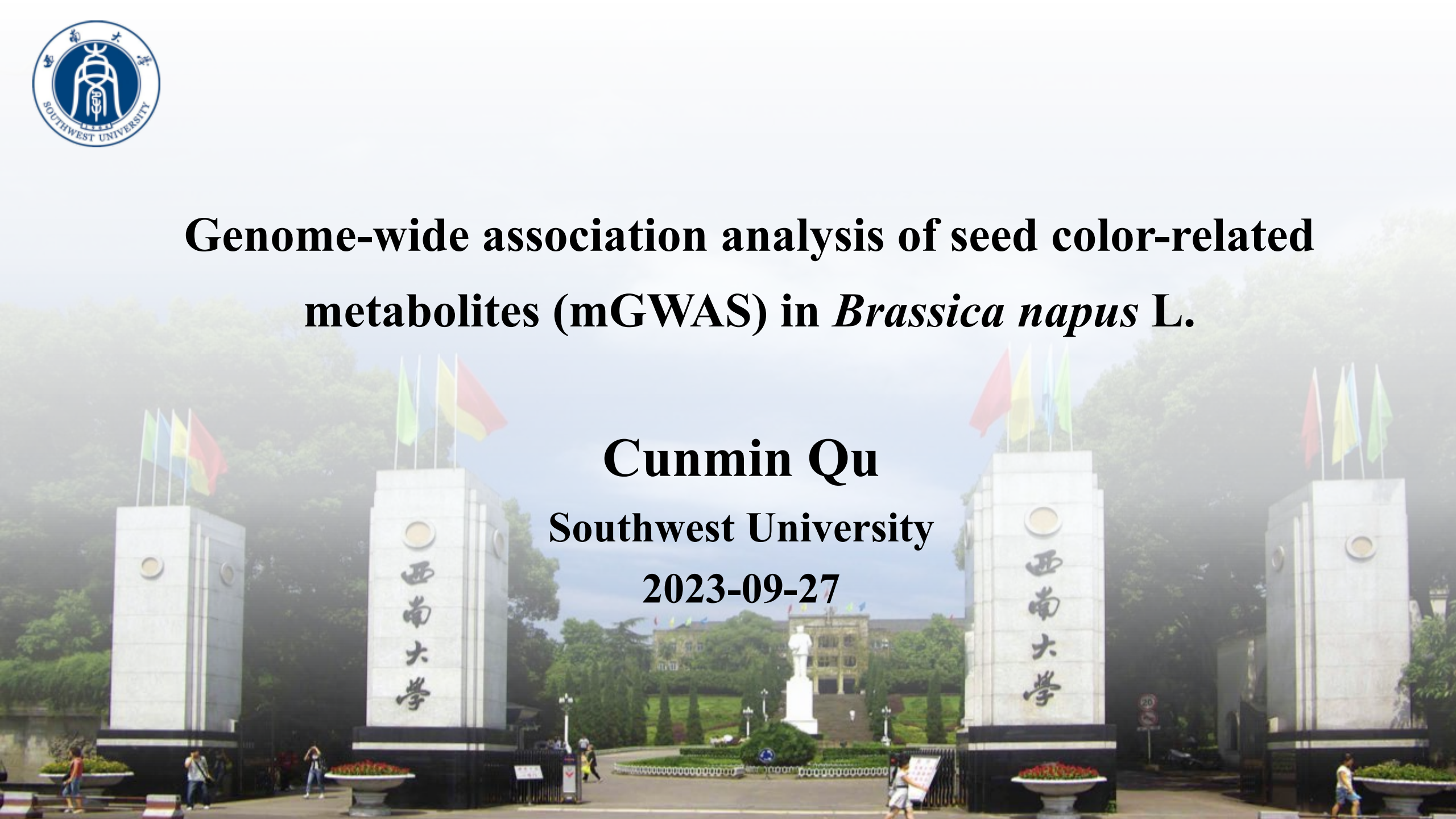
Genome-wide association analysis of seed color-related metabolites (mGWAS) in *Brassica napus* L.

Cunmin Qu

Southwest University

2023-09-27



Cotents

1. Backgrounds

Yellow-seeded *Brassica*

Thinner seed coat, higher proportion of protein and/or oil in seed;

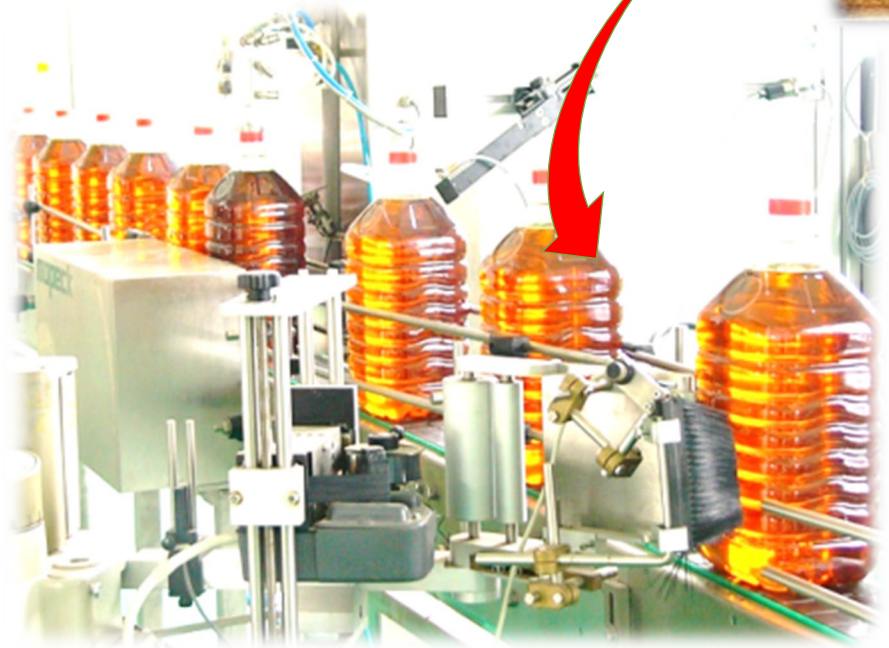
Lower anti-nutritive fiber, fewer condensed tannins and other pigments;

Source of edible oil, vegetable protein for feed and Rape oil-based Biodiesel.

1. Backgrounds

High commercial application

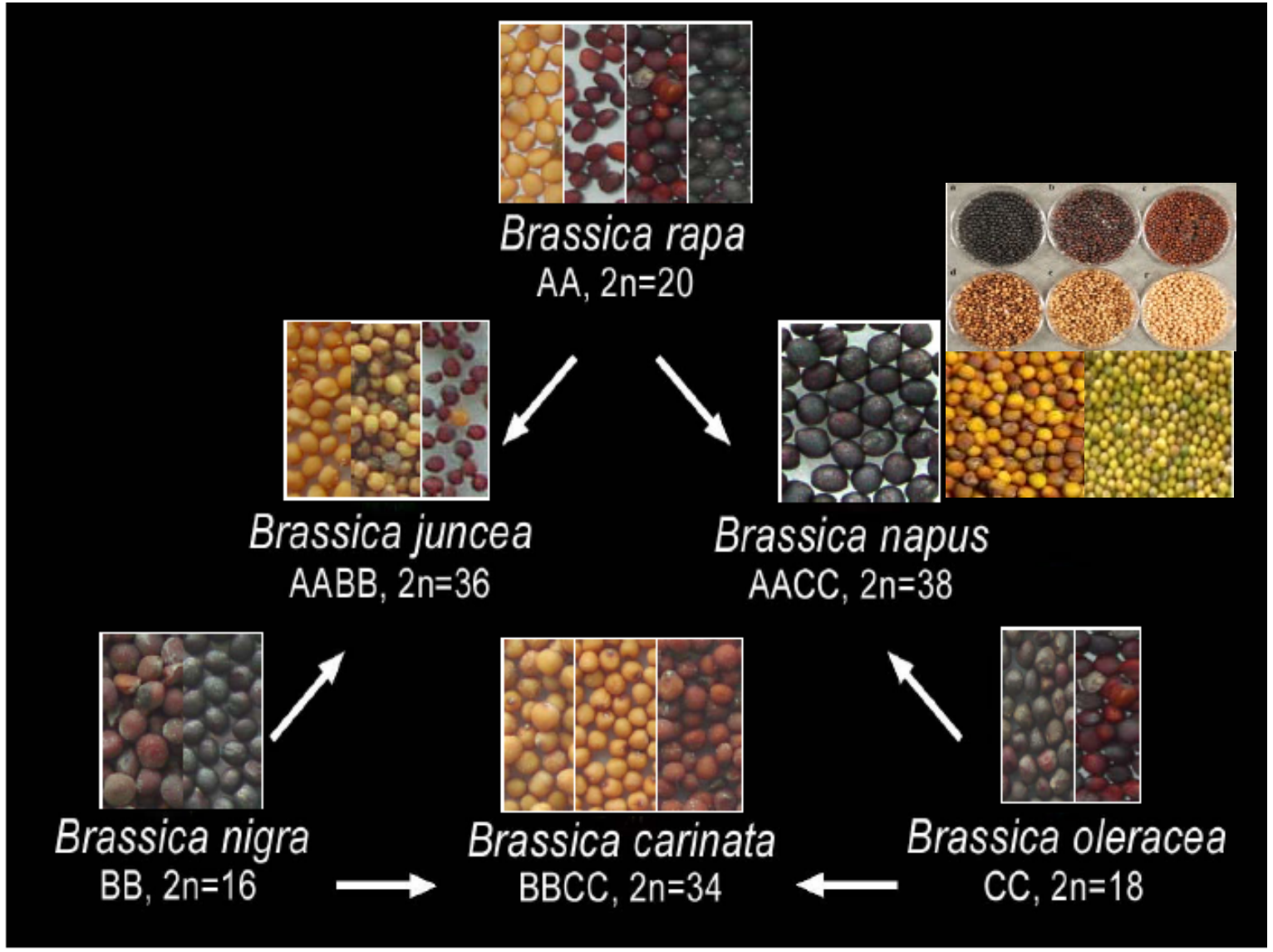
The price of yellow-seeded press oil and meal is higher 10-20% than that of black seeded cultivars.



Press oil

Yellow meal

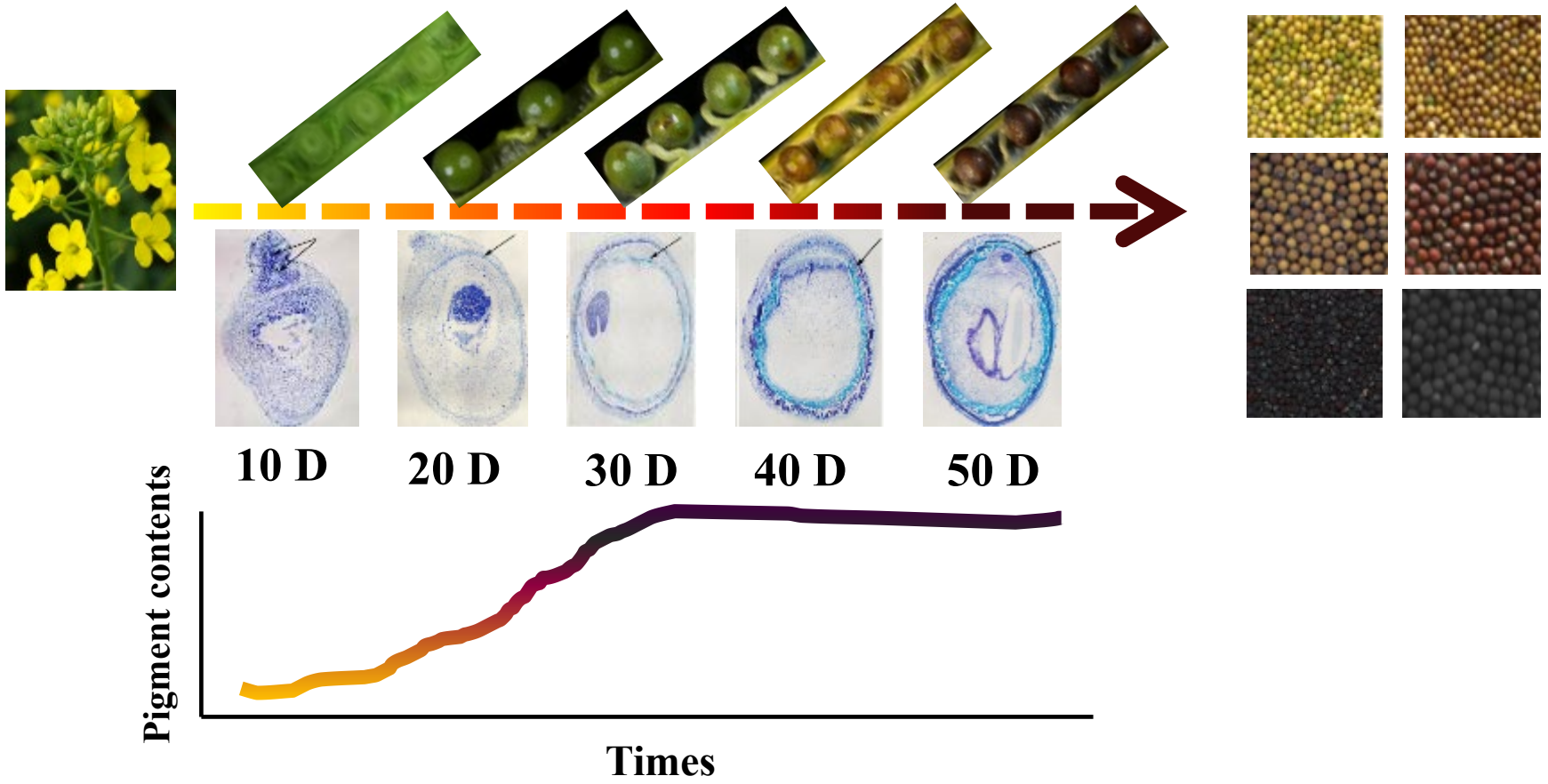
1. Backgrounds



Li et al., 2012; Liu et al., 2013; Marles et al., 2012; Rahman et al., 2010; Wang et al.,

1. Backgrounds

The pigments accumulation and seed coloration



Abundant accumulation of pigments during seed development may be lead to different color formation after maturation, regulated by many genes. (Qu et al., *JXB*, 2013)

2 DMetFinder V1.0

2. DMetFinder V1.0

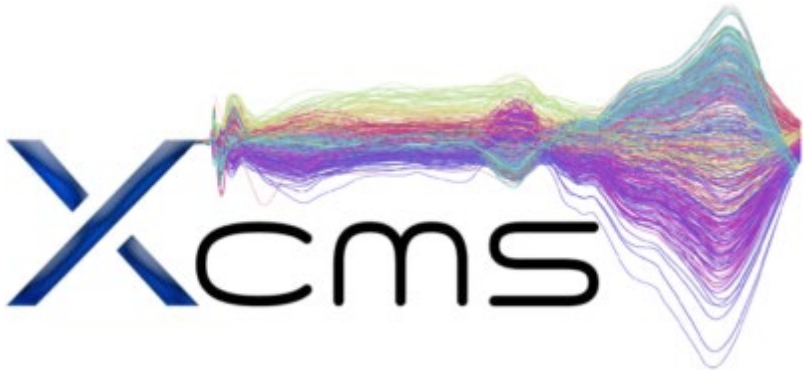
Business

MarkerView

Compound Discoverer

Free

MS-DIAL

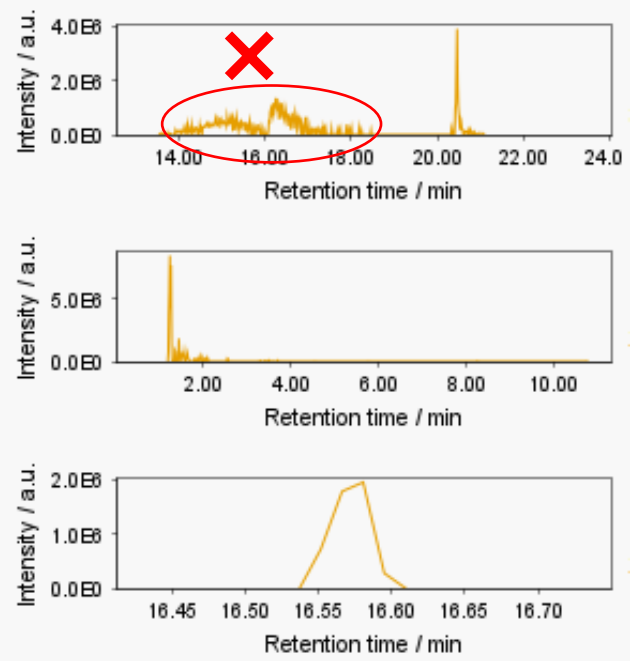


MZmine 2

2. DMetFinder V1.0

Disadvantages of MS data analysis

- Not full Covering
- Un-sensitivity for the low-abundance metabolites
- False positive and negative
- No identification standards based on ion chromatographic peak



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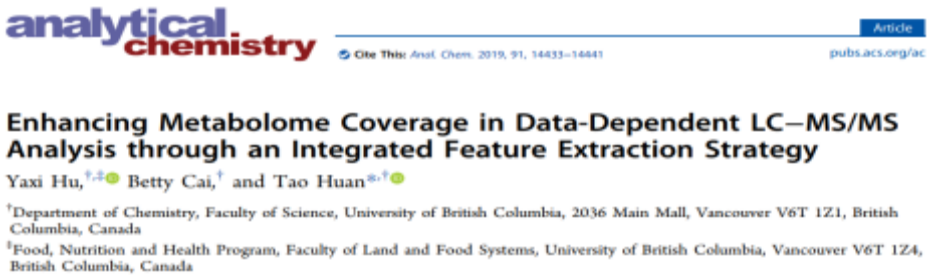
Comprehensive evaluation of untargeted metabolomics data processing software in feature detection, quantification and discriminating marker selection

Zhucui Li [a, b, c], Yan Lu [a, b, d], Yufeng Guo [c], Haijie Cao [e], Qinhong Wang [c], Wenqing Shui [b, d, *]



analytical chemistry

Article

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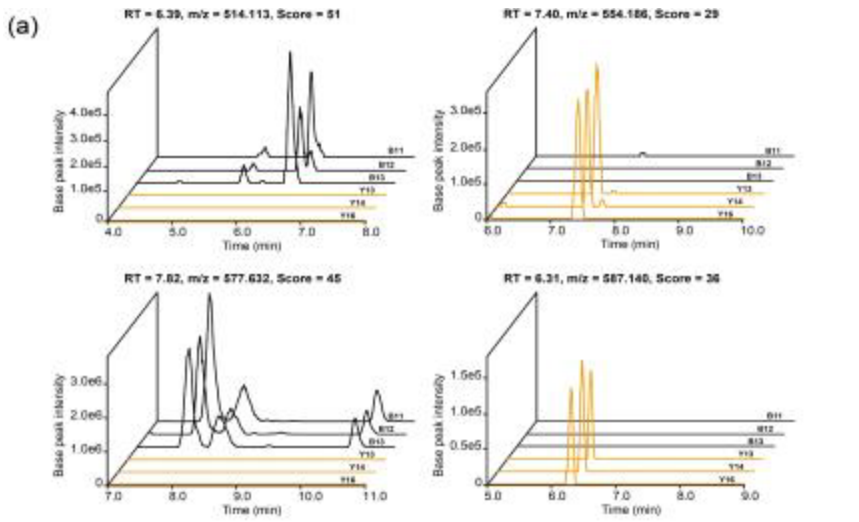
Enhancing Metabolome Coverage in Data-Dependent LC−MS/MS Analysis through an Integrated Feature Extraction Strategy

Yaxi Hu,[†,‡] Betty Cai,[†] and Tao Huan[*,†]

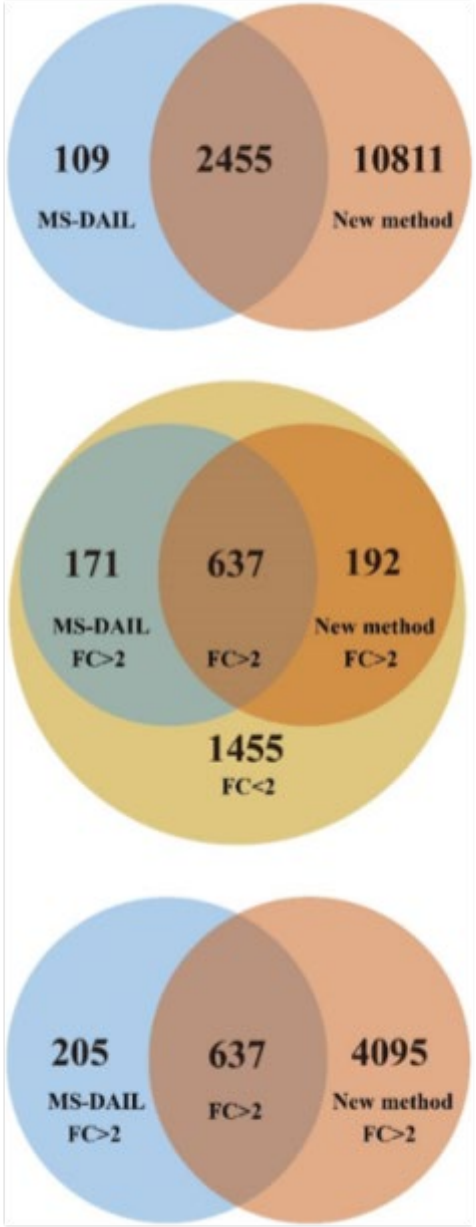
[†]Department of Chemistry, Faculty of Science, University of British Columbia, 2036 Main Mall, Vancouver V6T 1Z1, British Columbia, Canada

[‡]Food, Nutrition and Health Program, Faculty of Land and Food Systems, University of British Columbia, Vancouver V6T 1Z4, British Columbia, Canada

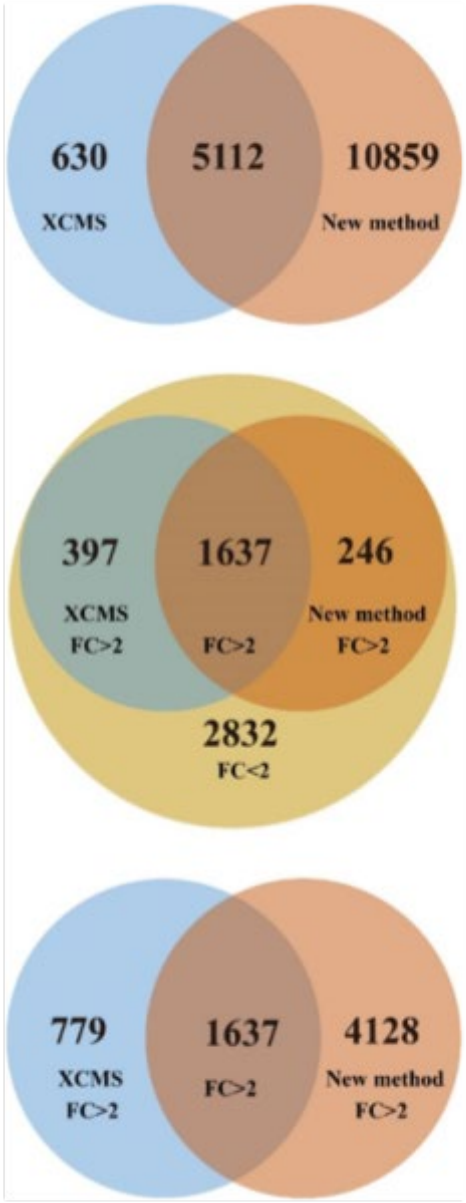
2. DMetFinder V1.0



MS-DAIL vs DMetFinder



XCS vs DMetFinder



2. DMetFinder V1.0

ID	RT	m/z	MS-DIAL	XCMS	Changing
3112	5.97	649.14496	0.33	1.73	1.61
1158	6.35	298.13018	0.20	1.65	0.57
46	6.86	121.02811	0.26	1.74	1.47
2664	10.60	547.10713	3.96	/	1.60
2534	14.69	518.2544	3.21	1.89	1.38
3194	14.07	693.3356	0.32	0.81	0.68
2345	14.66	474.26331	4.53	1.84	1.93
2650	15.03	544.26683	4.63	0.75	1.30
667	13.59	223.09704	4.31	0.22	1.37
977	16.40	271.22835	3.69	/	1.58

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V1.0

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开发完成日期：2021年05月20日

首次发表日期：未发表

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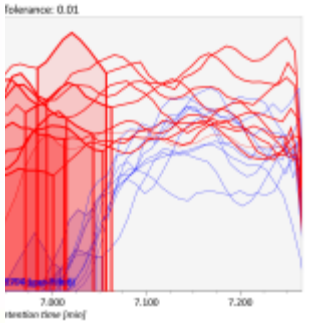
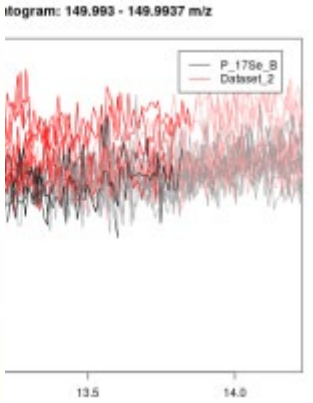
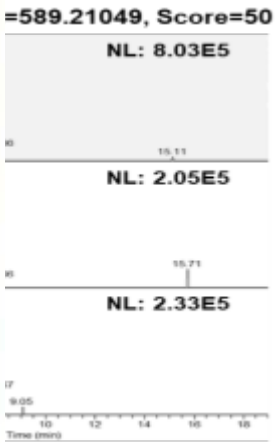
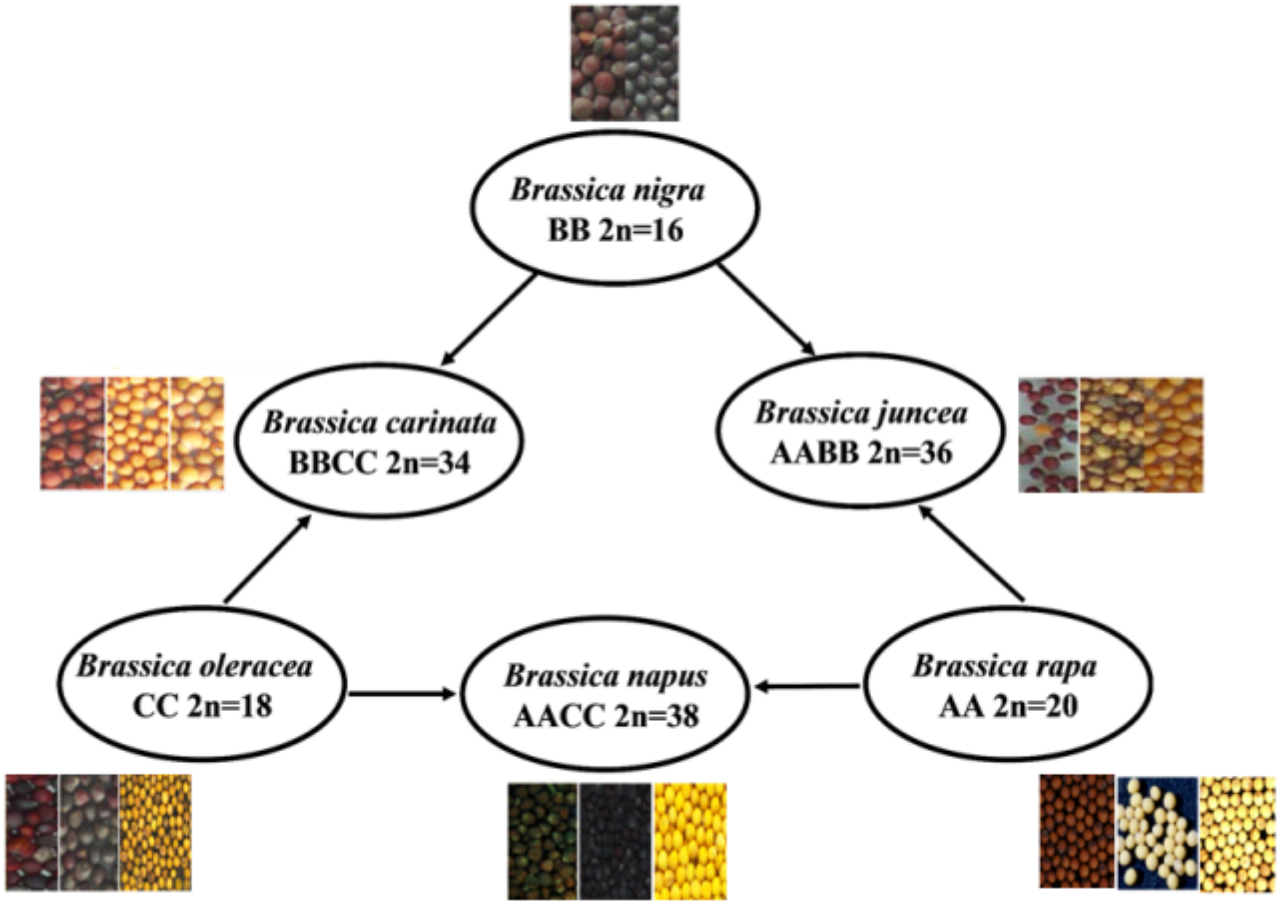






3 Metabolites in seeds of U-triangle species

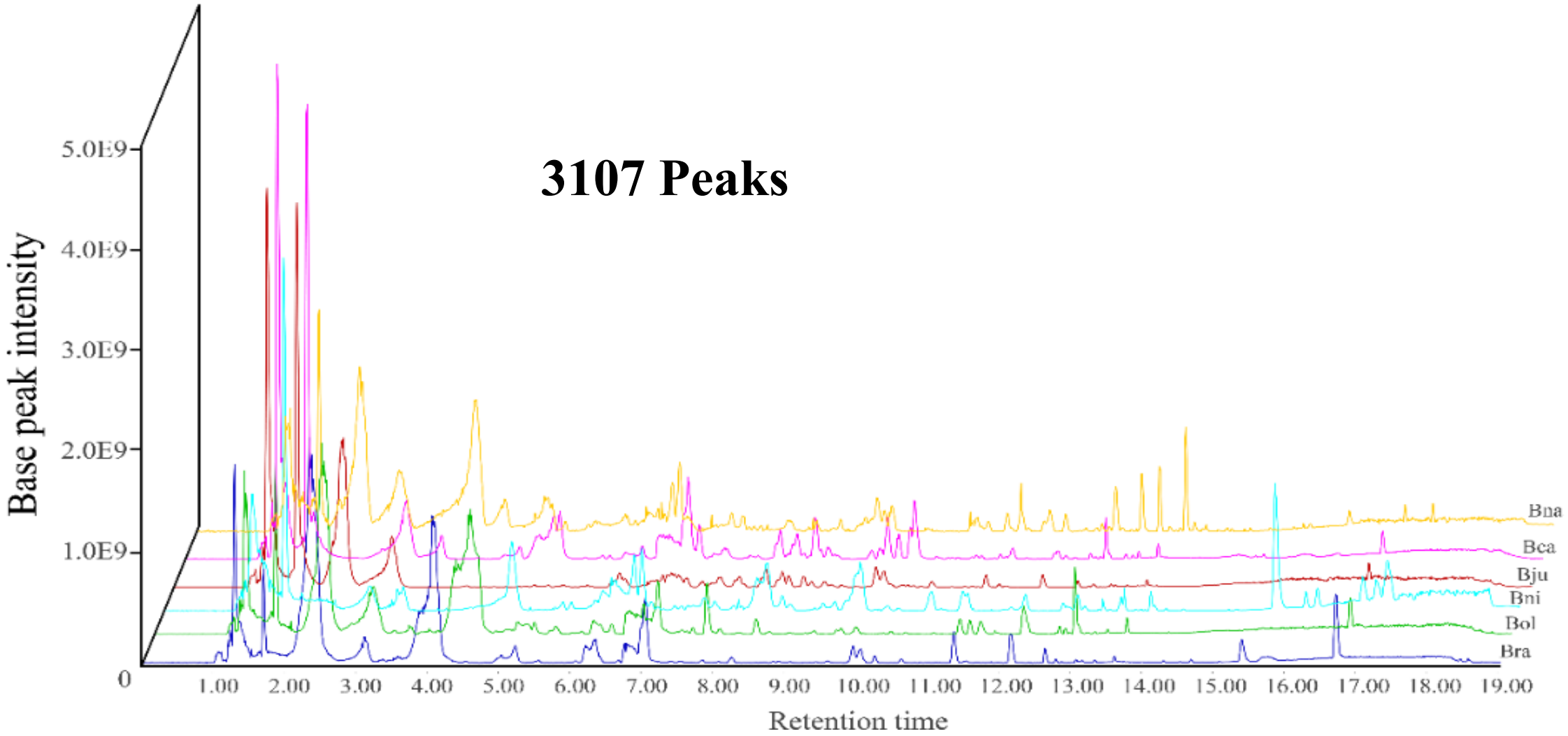
3. Metabolites in seed of U-triangle species



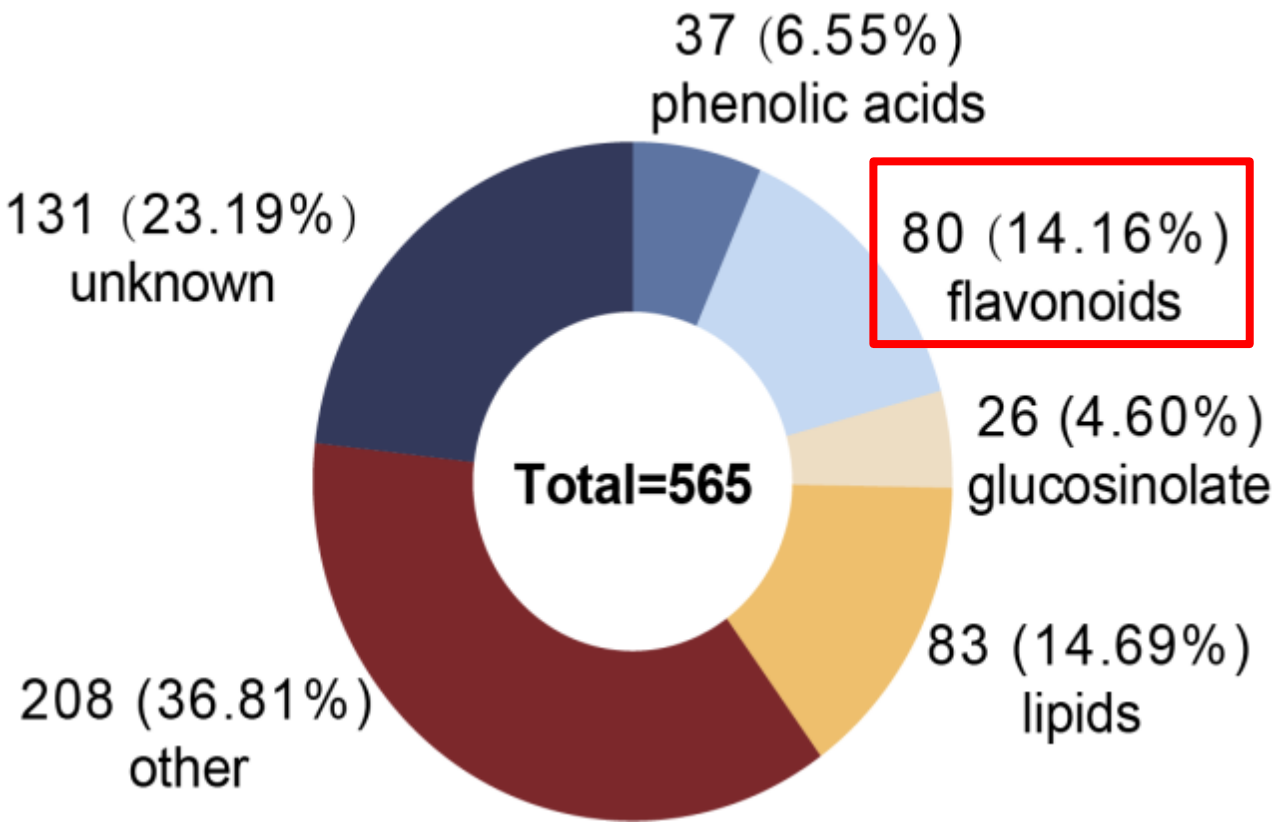
U's Triangle

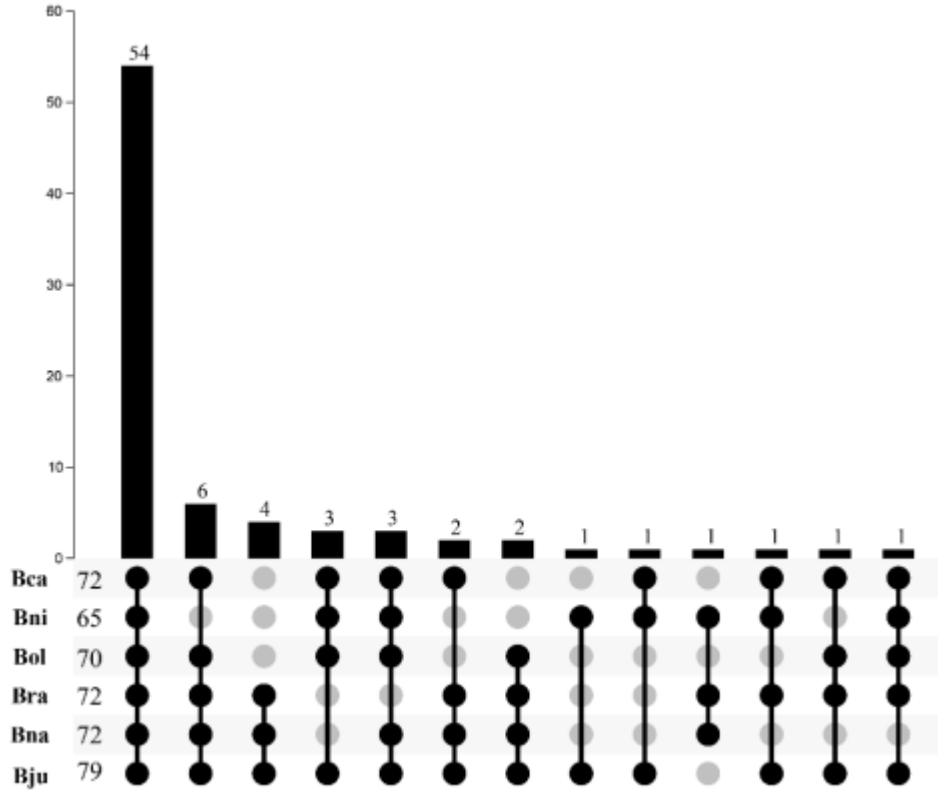
（Nagaharu, The Journal of Japanese Botany, 1935）

3. Metabolites in seed of U-triangle species



3. Metabolites in seed of U-triangle species



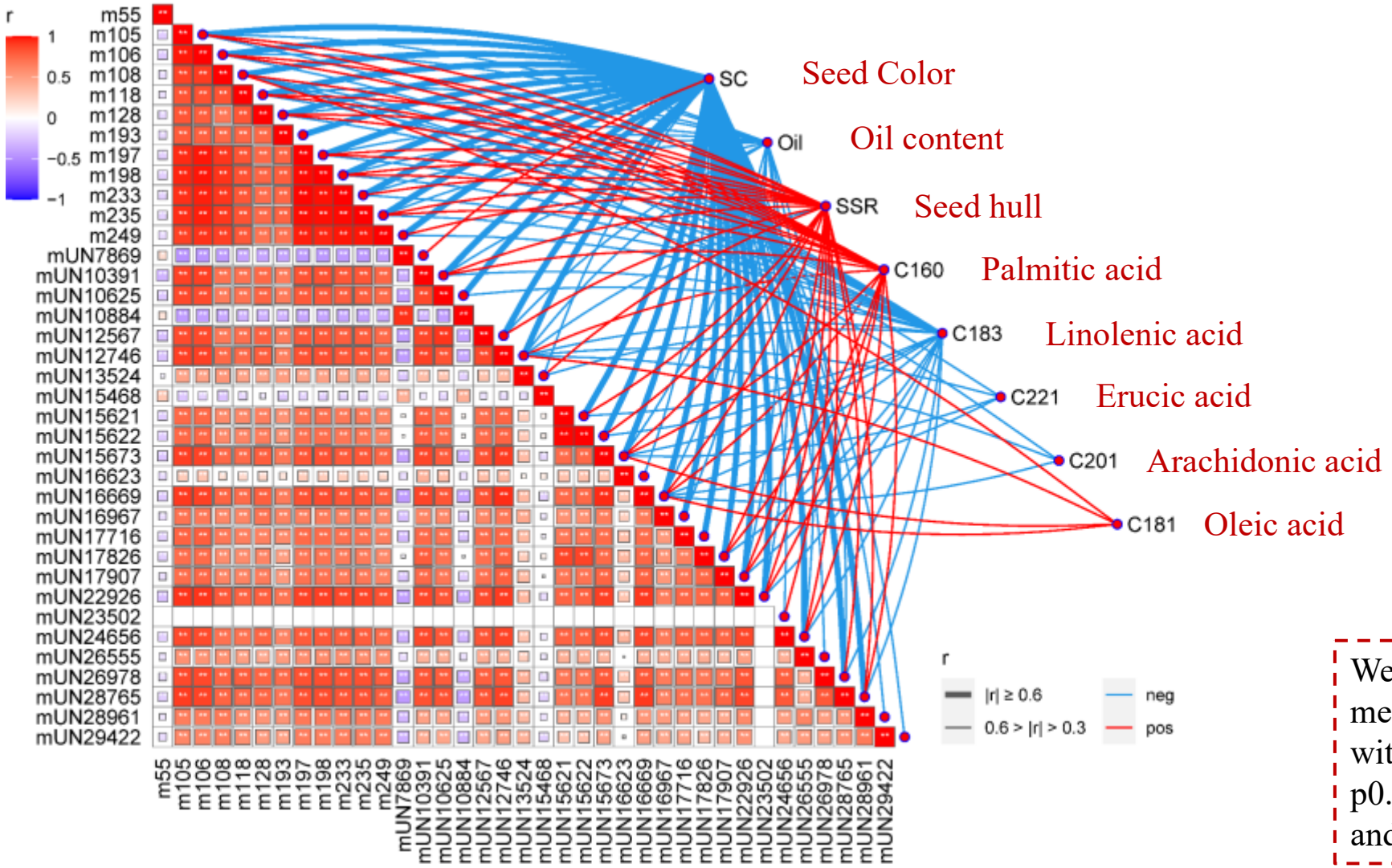


Flavonoids distribution

565/3107，18.18%

3. Metabolites in seed of U-triangle species

Analysis of differential metabolites with relative traits



Seed Color

Oil content

Seed hull

Palmitic acid

Linolenic acid

Erucic acid

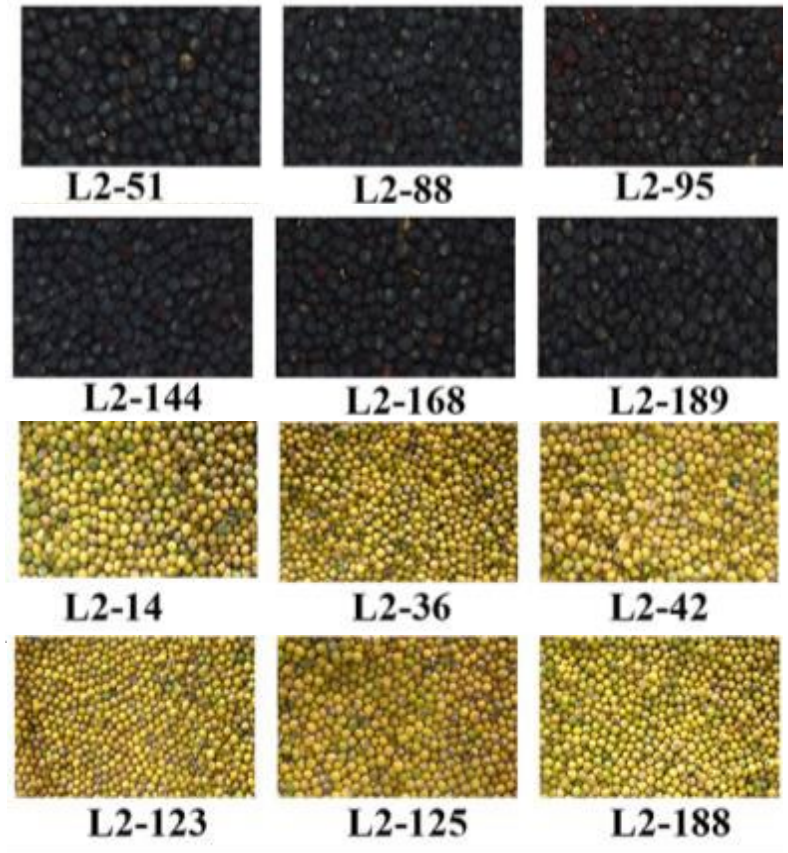
Arachidonic acid

Oleic acid

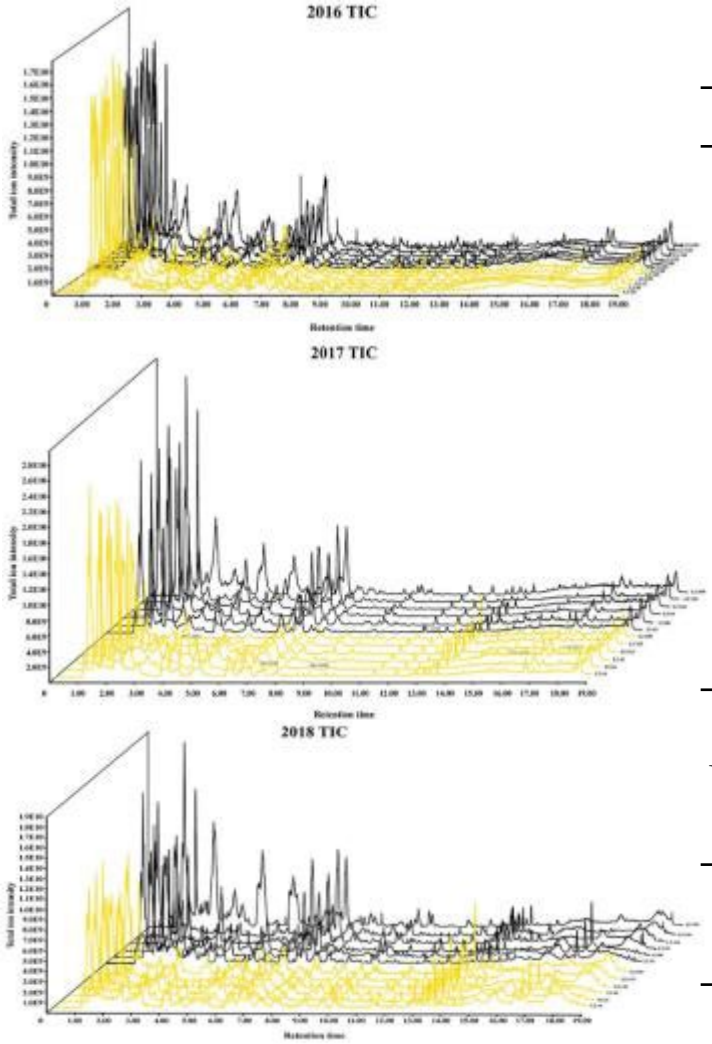
We obtained 27 differential metabolites (|r|>0.6, p<0.001) with high correlation (|r|0.6, p0.001) with different agronomy and quality traits.

4 mGWAS and Candidate genes selection

4. mGWAS and Candidate genes selection

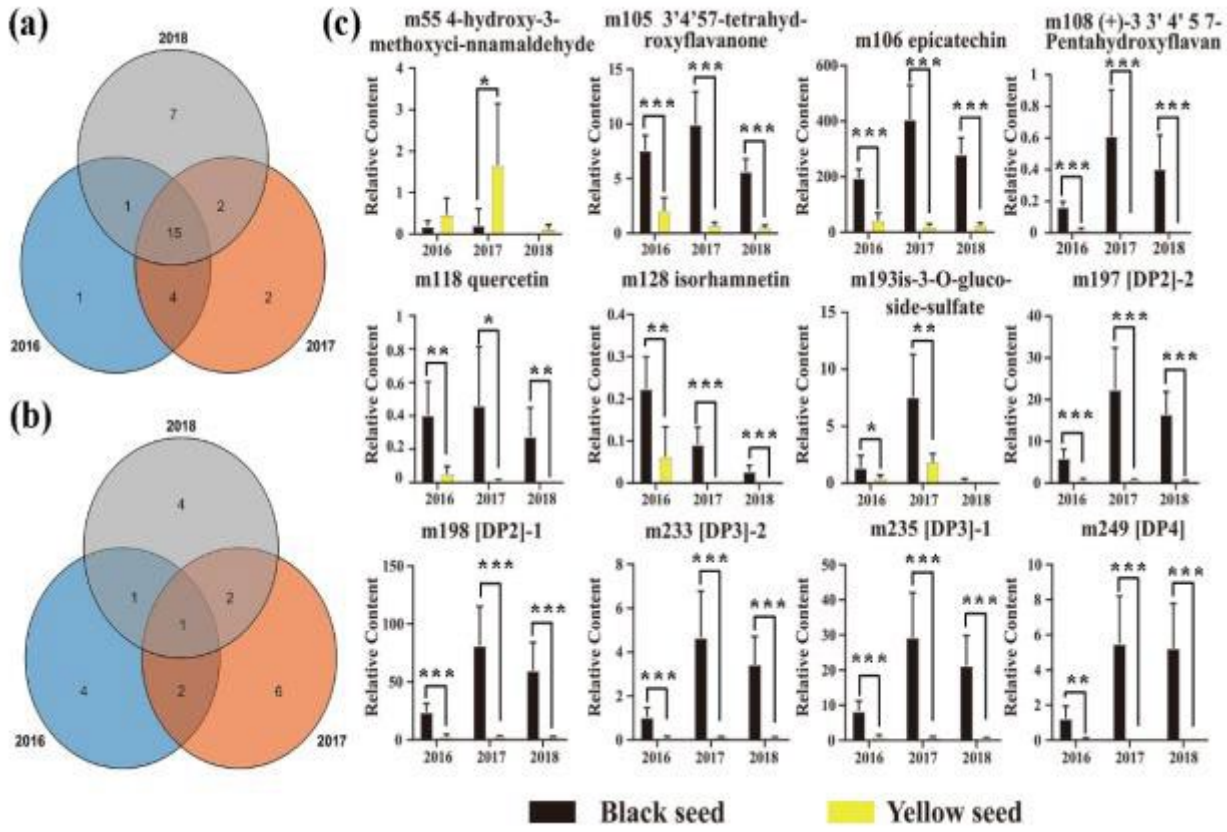


Yellow- and Black-seeded

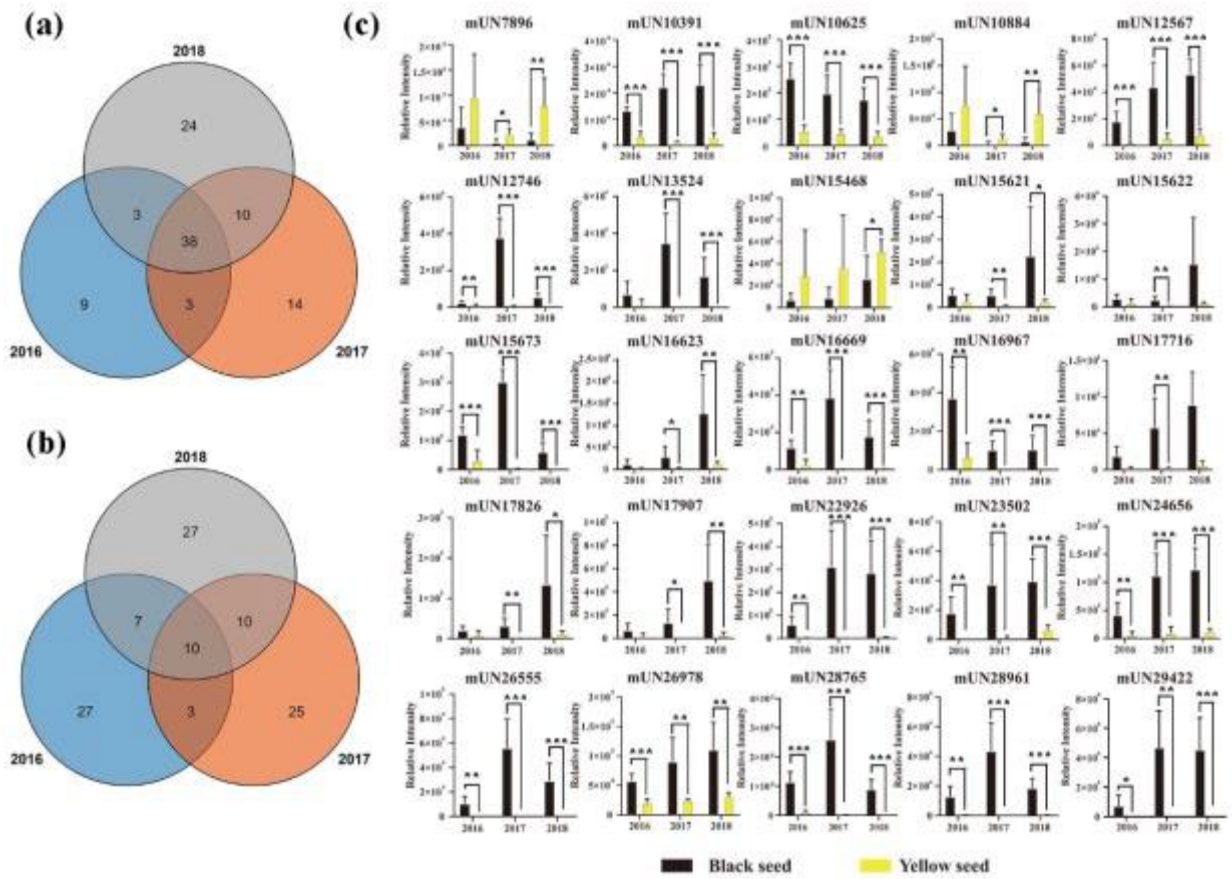


Category			NO.
Known（103）	Flavonoids（52）	Epicatechins	18
		Isorhamnetins	12
		Kaempferols	17
		Quercetins	5
	Phenolic acids（28）	Caffeic acids	4
		p-Coumaric acids	4
		Ferulic acids	3
		Sinapic acids	17
	Glucosinolates		23
Unknown			607
Total			710

4. mGWAS and Candidate genes selection



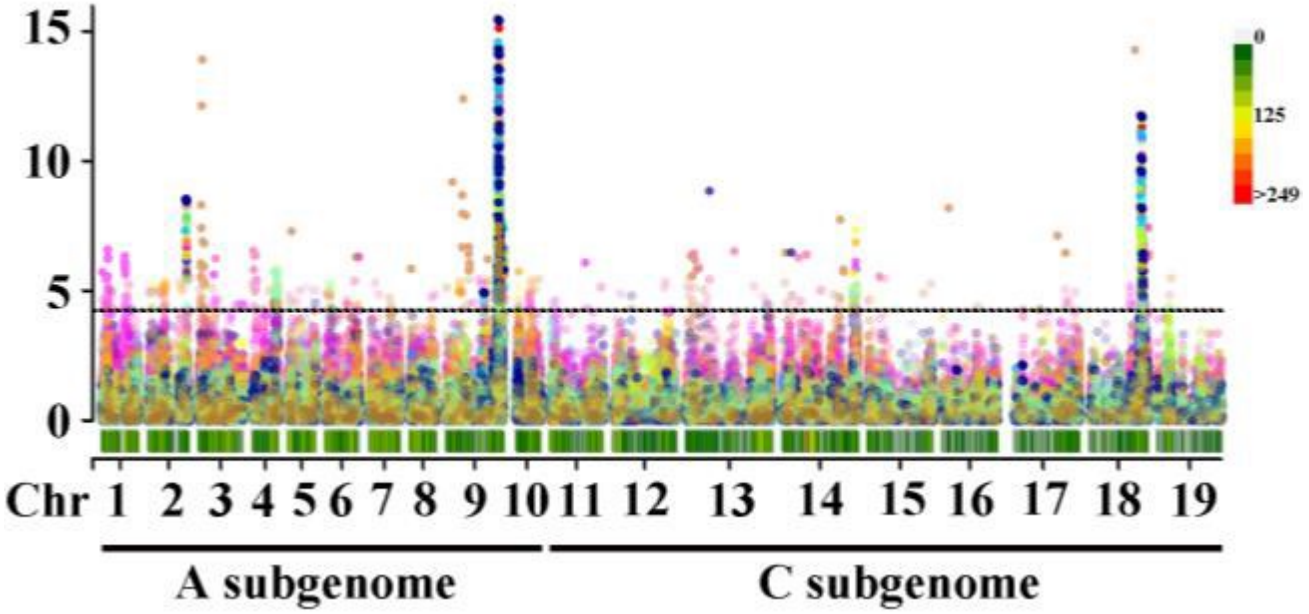
Known (12)



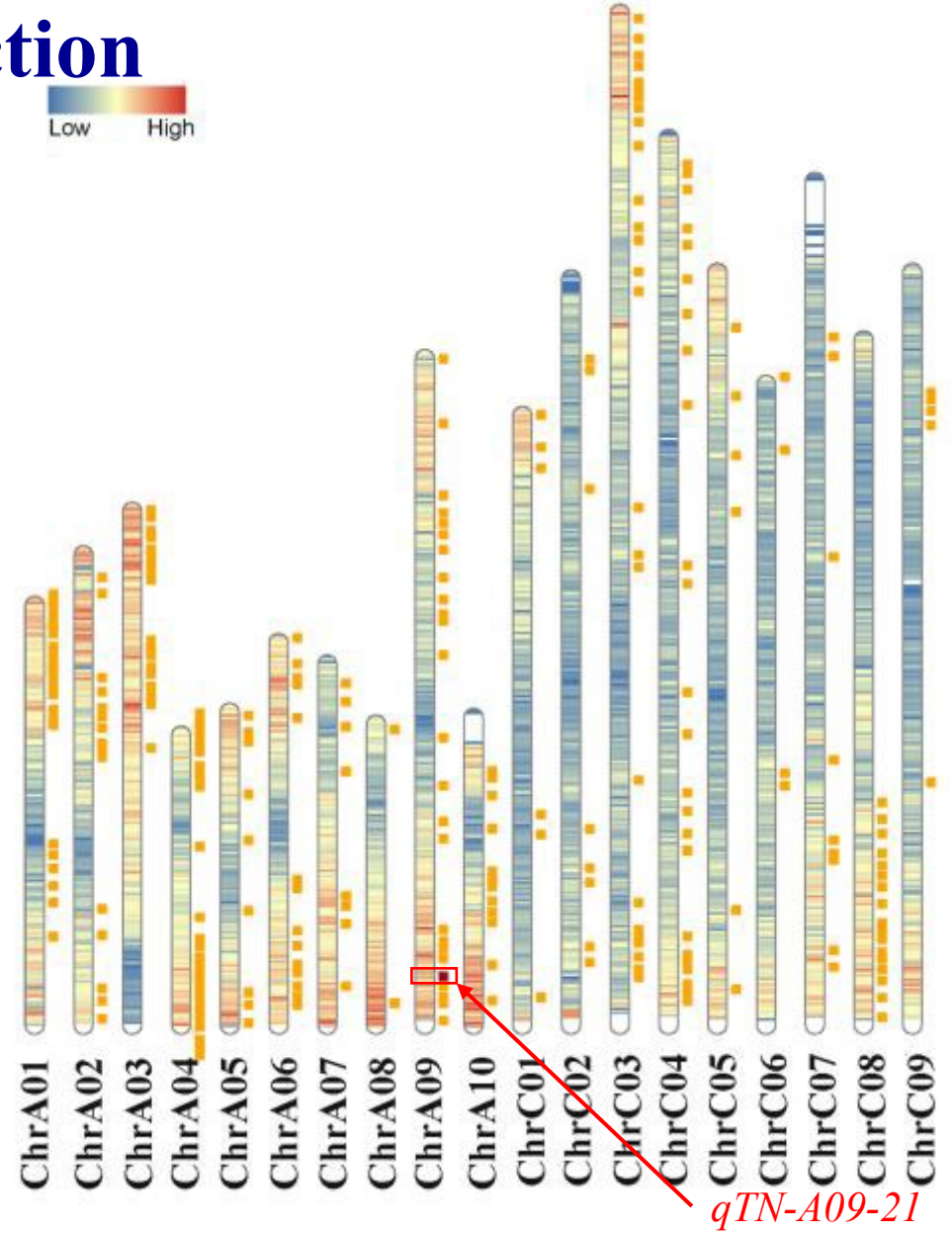
Unknown (25)

4. mGWAS and Candidate genes selection

mGWAS of the differential metabolites and seed color



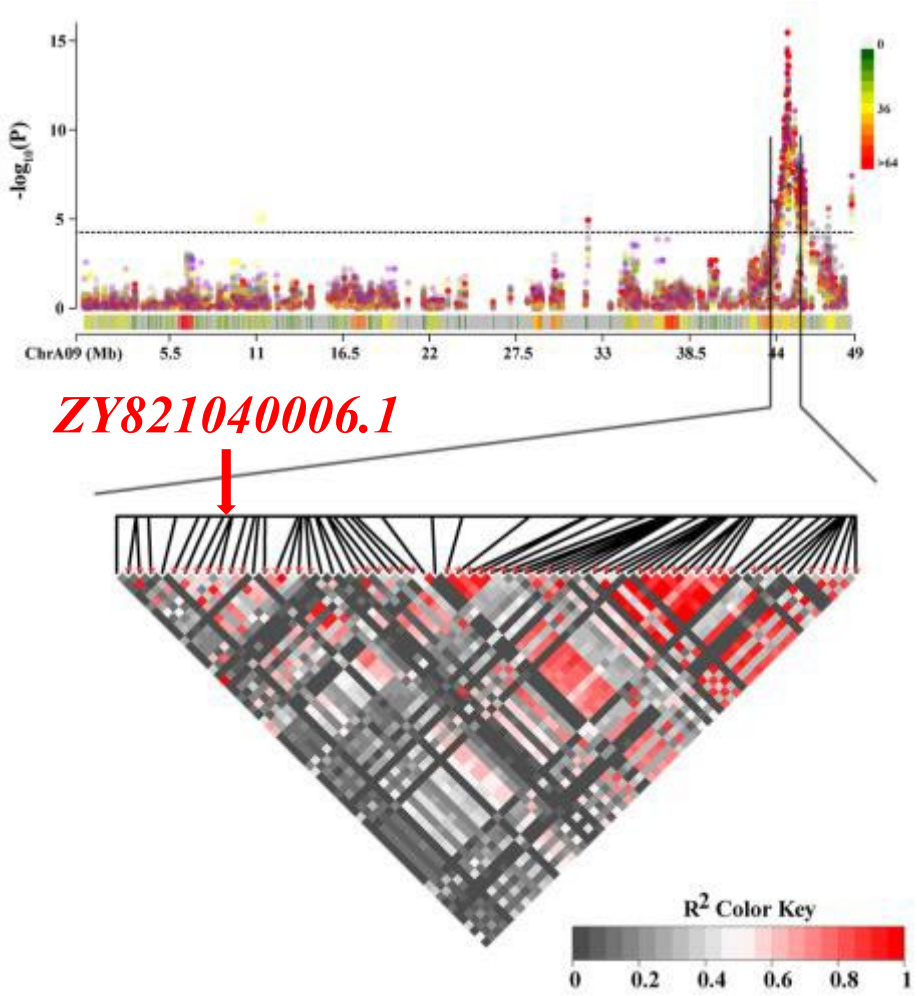
Manhattan diagram of differential metabolites

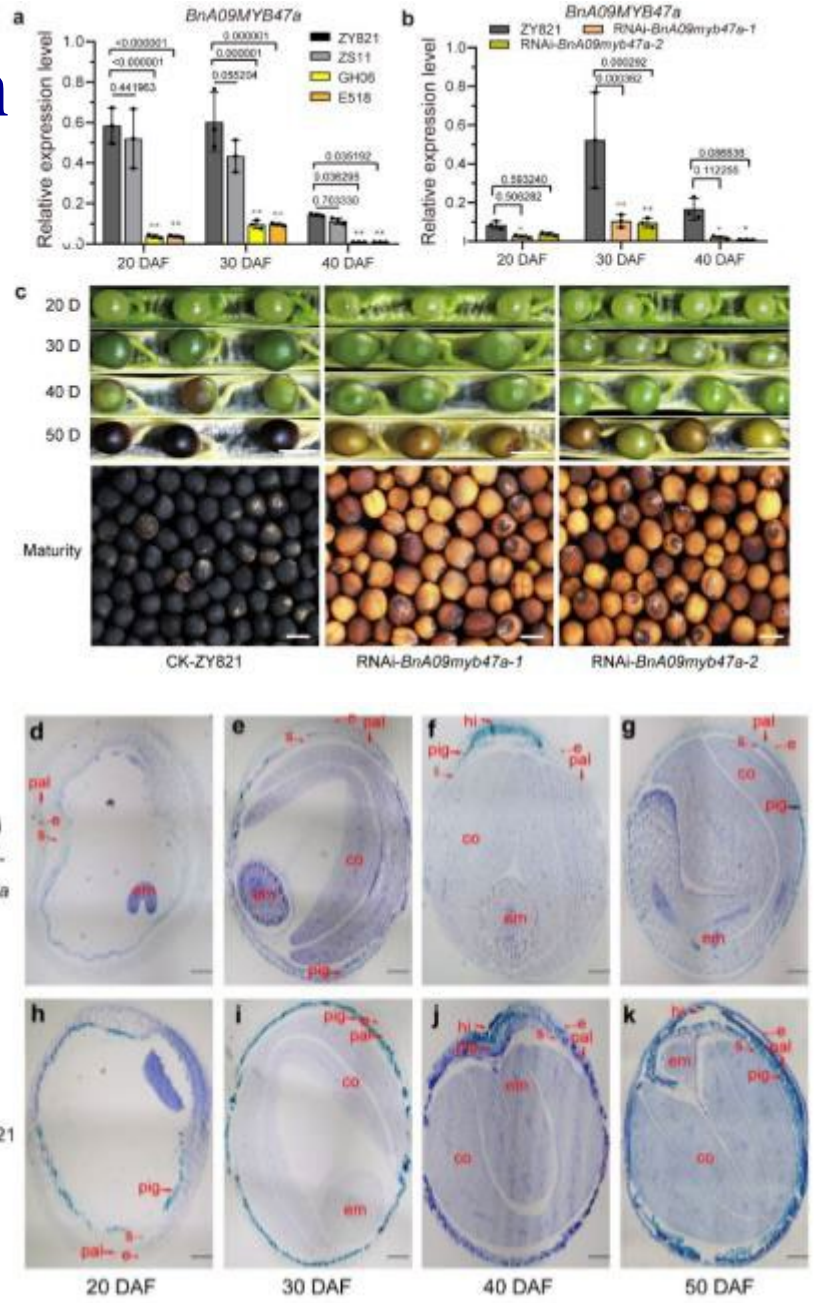


Candidate intervals distribution diagram

It was preliminarily determined that ***qTN-A09-21*** was an important candidate region for regulating the metabolism and synthesis of pigment differences, which was associated with the formation of color differences in *Brassica napus*.

4. mGWAS and Candidate genes selection

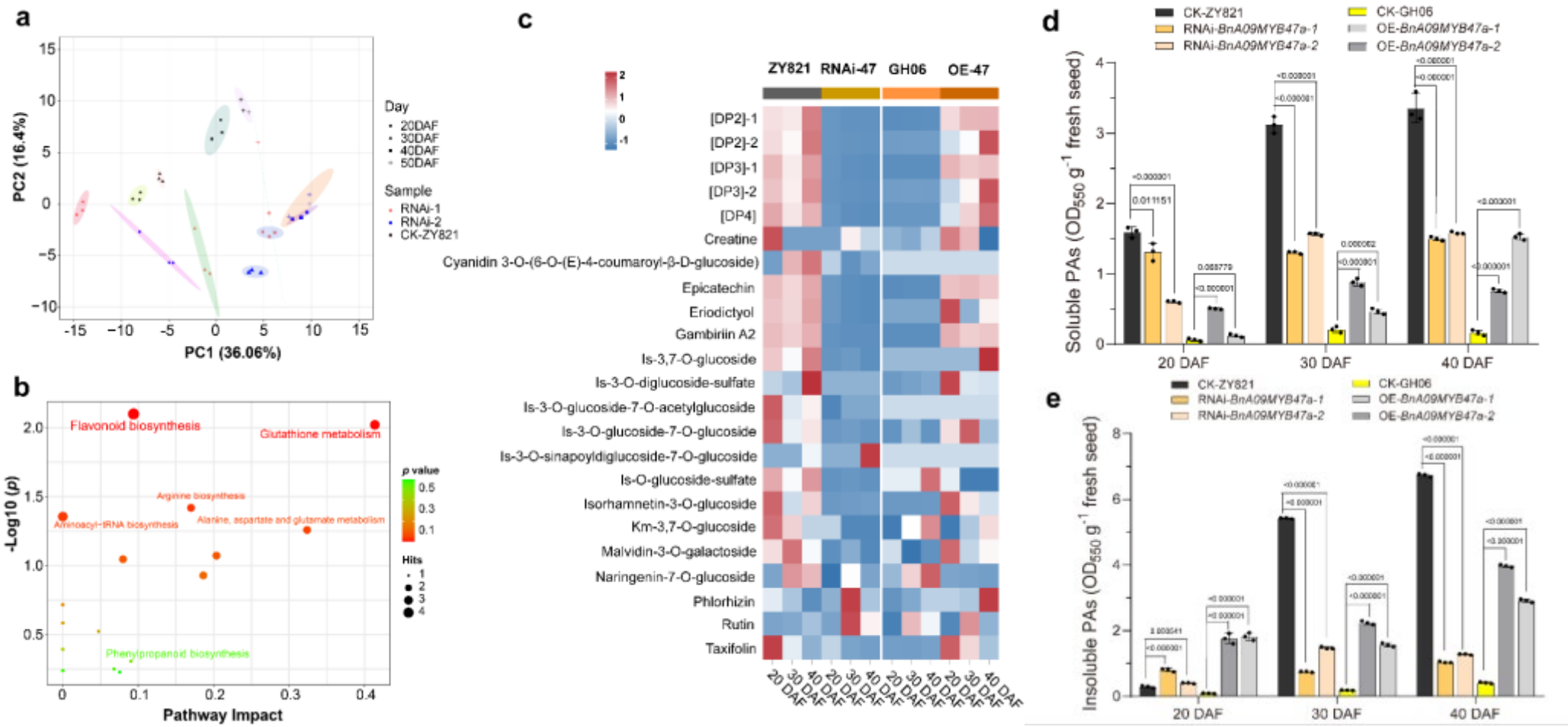




BnA09MYB47a is involved in seed color and pigmentations accumulation

Nature Communications, 2023

4. mGWAS and Candidate genes selection



BnA09MYB47a affects the accumulation of flavonoid components

Nature Communications, 2023

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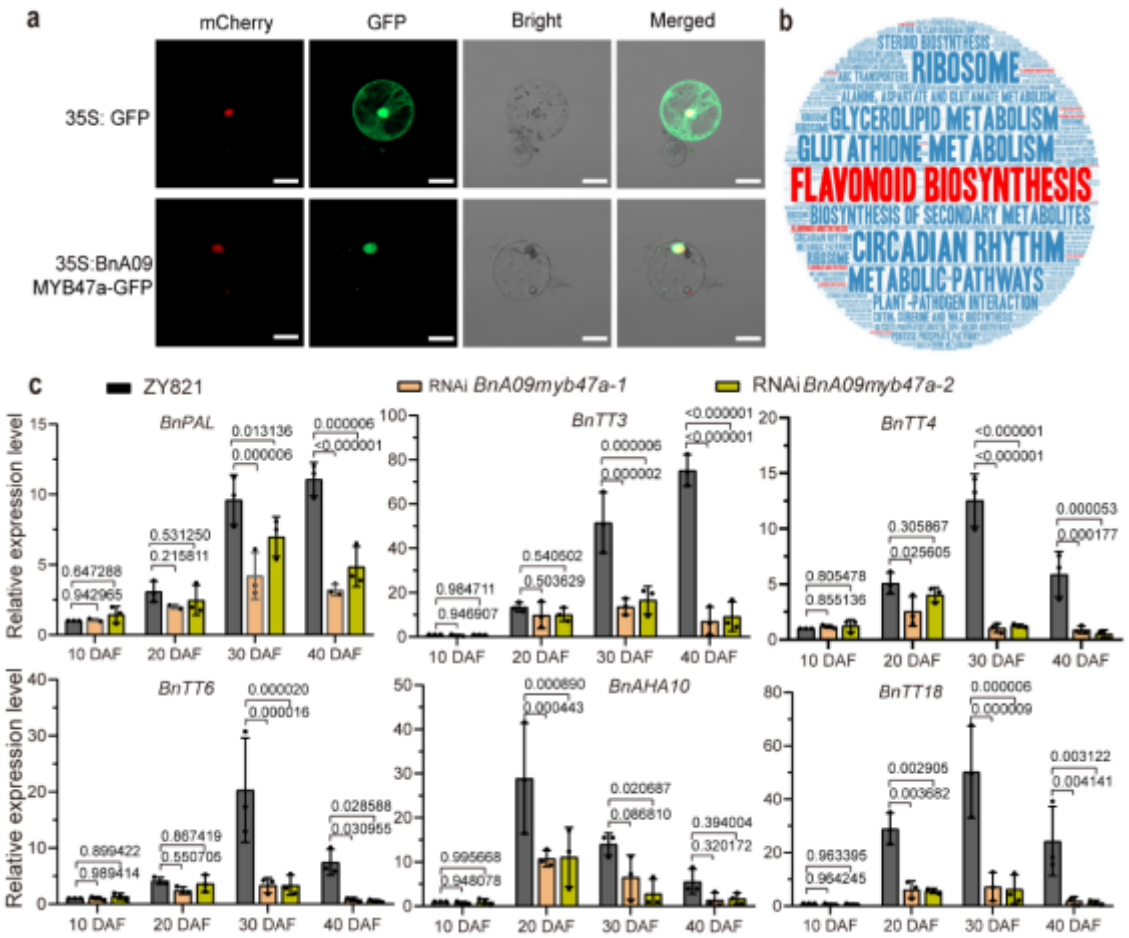

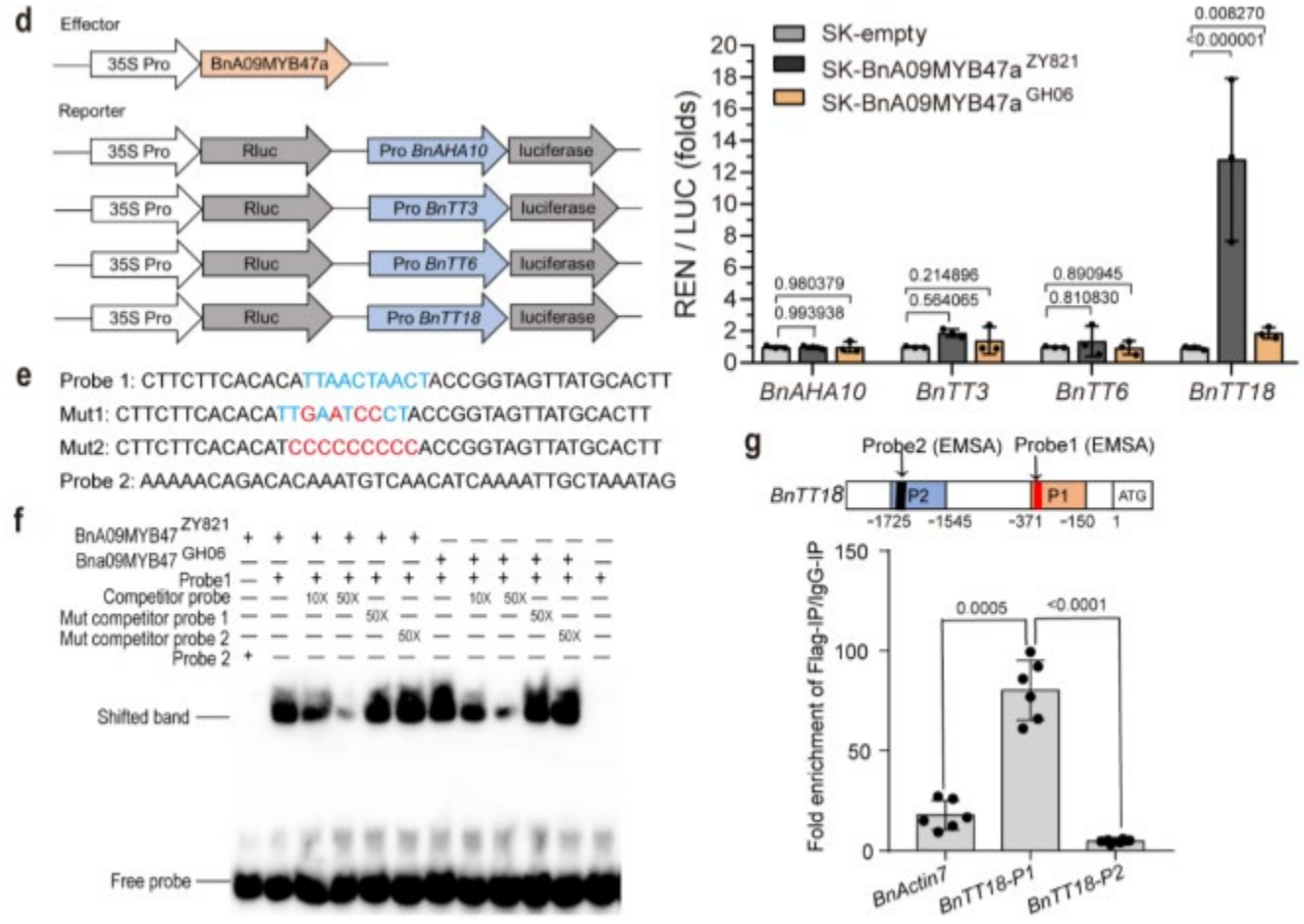

BnA09MYB47a directly regulates the flavonoid pathways

Nature Communications, 2023

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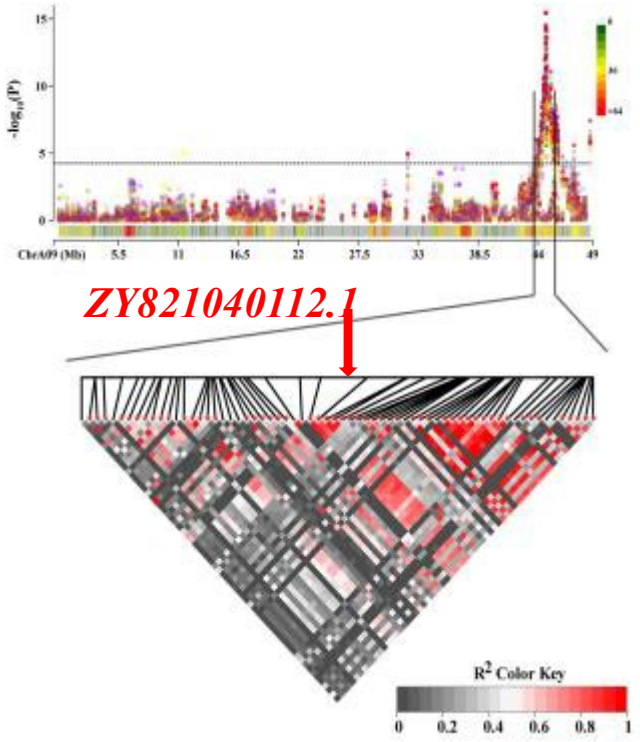
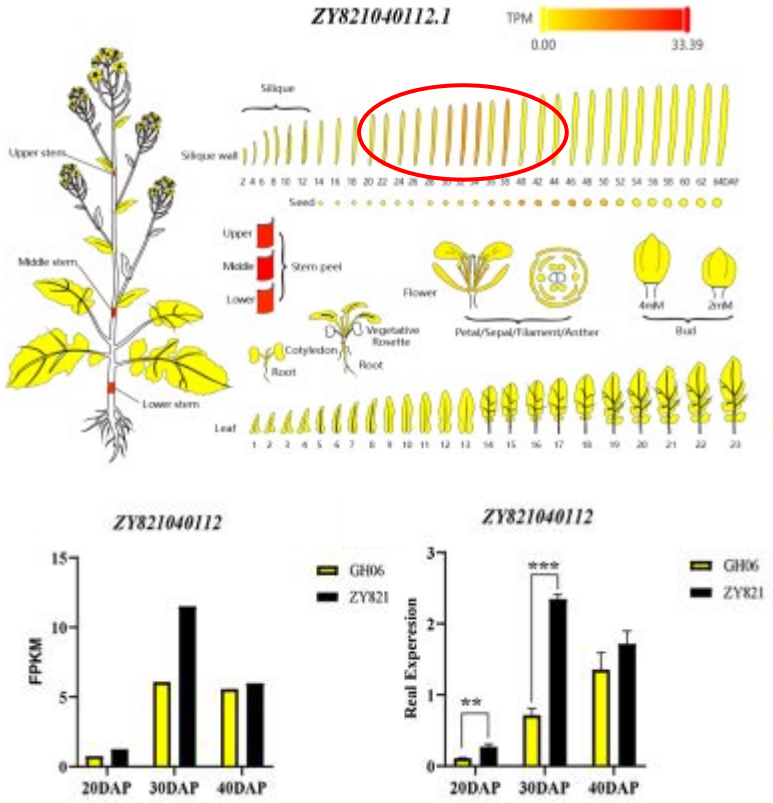
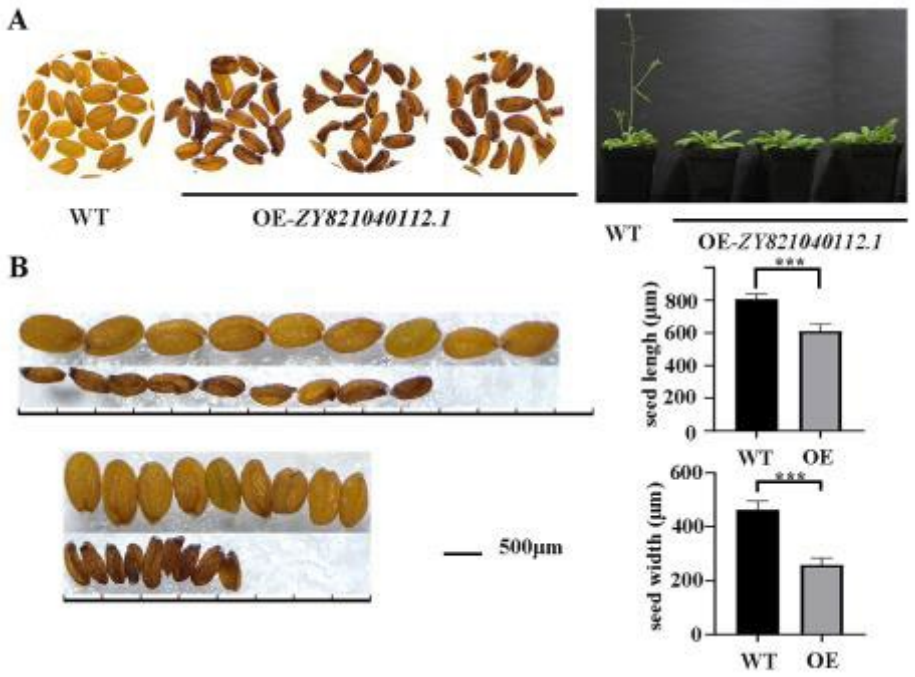




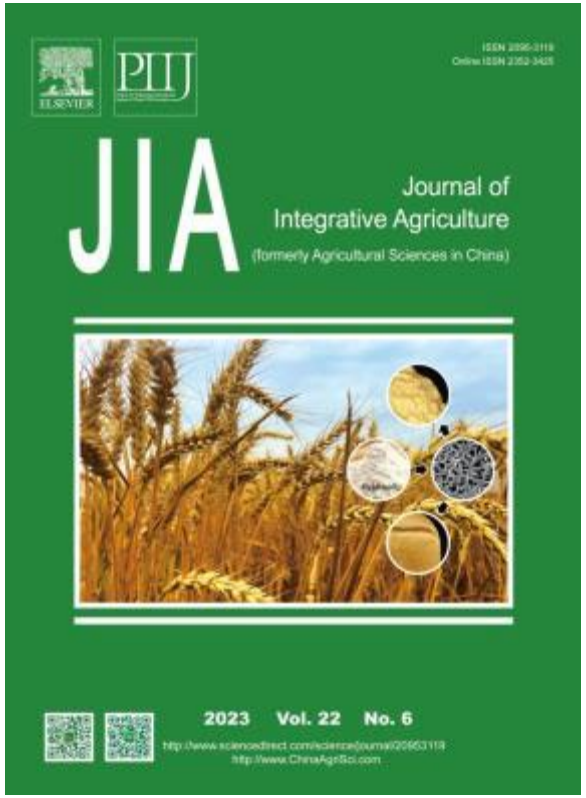


Biological functional identification of *ZY821040112.1* in *A. thaliana*

Conclusions

- **Developed DMetFinder V1.0 based on Base peak chromatograms**
- **Constructed the Metabolites database of seeds of U-triangle species, and identified the differentially metabolites between the yellow- and black-seeded rapeseed.**
- **Obtained the candidate interval *qTN-A09-21* for controlling seed coat color and pigmentations on chromosome A09, and fine-mapping the seed color genes *ZY821040006.1* (BnA09MYB47a) and *ZY821040112.1*.**

Journal of Integrative Agriculture



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