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International Union for the Protection of New Varieties of Plants

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CONSTRUCTION AND APPLICATION OF MOLECULAR FINGERPRINT DATABASES FOR VEGETABLE VARIETIES

Document prepared by an expert from China

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The annex to this document contains a presentation “Construction and application of molecular fingerprint databases for vegetable varieties”, to be made by an expert from China, at the fourth session of the TWM.

[Annex follows]

CONSTRUCTION AND APPLICATION OF MOLECULAR FINGERPRINT DATABASES FOR VEGETABLE VARIETIES

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TWM4, Cambridge, Jun 2 to 6, 2026

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Laboratory Introduction

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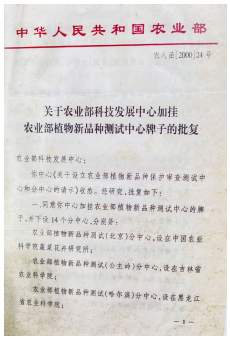
1. LABORATORY INTRODUCTION

- Established in **2000** as the Beijing Sub-center of New Plant Variety Tests
- Initiated construction of **DNA fingerprint database for protected varieties** in **2009**
- Accredited as a **China Accredited Seed Laboratory (CASL) certificate** in **2024**



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1. LABORATORY INTRODUCTION

All databases are constructed in compliance with national and industrial standards.

Crop	Marker Type	Datebase Entries
Maize	SSR	~2449
Tomato	SSR	~2838
Cucumber	SSR	~2469
Cabbage	SSR、SNP	~245
Zucchini（Summer squash）	SSR	~186
Pinto beans	SSR	~75

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1. LABORATORY INTRODUCTION

Our Testing Scope under CASL Accreditation

Varietal genuineness identification	Varietal Purity	Genetically modified organism (GMO) seed testing
maize, wheat, rice, soybean, cucumber, cabbage, pepper, common bean, tomato, watermelon, melon, potato, Chinese cabbage, radish, lily, sunflower, non-heading Chinese cabbage, and scallion	maize	maize, rice, wheat, soybean, cotton, rapeseed, tomato, melon, watermelon, cabbage, cucumber, pepper, zucchini

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02

National Policies and Technical Progress

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2. NATIONAL POLICIES AND TECHNICAL PROGRESS

1. **Seed Law of the People's Republic of China (**Article 46)

Authorities may conduct rapid seed variety testing; results serve as a basis for administrative penalties.

2. **Judicial Interpretation (2021, Supreme People's Court)**

Article 23: If molecular marker differences approach the threshold, the infringer bears the burden of proof.

Article 24: In case of conflict, **field DUS testing prevails** over molecular identification.

Agricultural, rural, forestry, and grassland authorities may test/assess varieties in so

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2. NATIONAL POLICIES AND TECHNICAL PROGRESS

3. Policy for Variety Approval (2025, MARA)

Article 11: DNA fingerprints of parental lines must be submitted prior to variety approval.

4. Registration Measures for Non-Major Crops (2025 Revision)

Article 13: New varieties must submit a DNA fingerprint report if industry standards are available.

Competent agricultural, rural, forestry, and grassland authorities may test seed varieties in com

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2. NATIONAL POLICIES AND TECHNICAL PROGRESS

National standard development: SSR industry standards for over 70 crops, SNP industry standards for more than ten crops, and MNP standards for more than ten crops have been officially released.

Species	Markers used	Species	Markers used
Maize	SSR、SNP	**Chinese cabbage**	SSR、MNP
Wheat	SSR、SNP、MNP	**Non-heading Chinese cabbage**	SSR
Rice	SSR、SNP、MNP	**Radish**	SSR
Soybean	SSR	**Peper**	SSR
Tomato	SSR、SNP	**Cauliflower**	SSR
Watermelon	SSR、SNP	**Eggplant**	SSR
Melon	SSR、SNP	**Mustard**	SSR
Cucumber	SSR、SNP	**Bitter gourd**	SSR
Cabbage	SSR、SNP	**Lettuce**	SSR
Summer squash	SSR	**Common bean**	SSR
.....	.....	.....	.....

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2. NATIONAL POLICIES AND TECHNICAL PROGRESS

National Fingerprint Database Status

Crop	SSR(Entries)	SNP(Entries)
Maize	~16000	~10000
Rice	~12800	~5000
Wheat	~8600	~8000
Soybean	~5000	/
cotton	~4000	/
Sunflower	~1800	/
Cucumber	~1586	/
Watermelon	~2959	/
Melon	~1966	/
Tomato	~2338	/
Potato	~600	/

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Application and Practice

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3. APPLICATION AND PRACTICE

SSR vs. Phenotype (Cucumber)

Phenotypic difference in Cucumber variety pairs with 0-3 SSR locus differences

Sample ID	Sample ID	Total Differential Sites(SSR)	Homozygous Differences	Heterozygous Differences	Differential Traits
H203	H204	0	0	0	No obvious difference
HH310	HH311	0	0	0	No obvious difference
HH310	HH312	0	0	0	No obvious difference
HH311	HH312	0	0	0	No obvious difference
H356	H360	0	0	0	No obvious difference
H389	H343	0	0	0	No obvious difference
H412	H401	0	0	0	No obvious difference
HH3	HH40	0	0	0	14: leaf blade: intensity of green color
HH32	HH31	0	0	0	44: fruit: size of warts
HH113	HH16	0	0	0	26: fruit: shape of calyx end; 27: fruit: shape of stem end
HH21	HH80	1	0	1	No obvious difference
HH32	HH47	1	0	1	No obvious difference
HH57	HH59	1	0	1	No obvious difference
H215	H216	1	0	1	No obvious difference
H215	H217	1	1	0	7: plant: growth vigour; 19: ovary: bristle; 21: time of beginning harvest
H216	H218	1	1	0	No obvious difference
H217	H218	1	0	1	No obvious difference
HH31	HH47	1	0	1	No obvious difference
HH22	HH37	2	0	2	No obvious difference
HH202	HH209	2	2	0	30: fruit: ground color of skin at market stage
H215	H218	2	1	1	No obvious difference
H216	H217	2	1	1	No obvious difference
HH28	HH80	3	0	3	No obvious difference
HH202	HH212	3	3	0	22: fruit: shape; 30: fruit: ground color of skin at market stage
H203	HH209	3	3	0	37: fruit: length of yellow line on skin
H204	HH209	3	3	0	30: fruit: ground color of skin at market stage
H205	H207	3	3	0	27: fruit: shape of calyx end
H205	HH209	3	3	0	27: fruit: shape of calyx end
H206	HH212	3	3	0	27: fruit: shape of calyx end

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3. APPLICATION AND PRACTICE

SSR vs. Phenotype (Cucumber)

SSR locus differences and phenotypic variation in Cucumber variety pairs with high phenotypic correlation

Sample ID	Sample ID	Phenotypic Correlation Coefficient	Total Differential Sites（SSR）	Differential Traits
BJHHG63	BJHHG62	0.995082501	0	No obvious difference
BJHHG25	BJHHG27	0.994260088	0	No obvious difference
BJHHG26	BJHHG27	0.991732055	0	No obvious difference
BJHHGS209	BJHHGS221	0.991529339	5	No obvious difference
BJHHG808	BJHHG88	0.991445075	14	5:leaf blade: intensity of green color; 9: leaf blade: length
BJHHG411	BJHHG413	0.991311857	11	21: fruit: length; 27.fruit: shape of calyx end
BJHHG613	BJHHG705	0.99	10	3: plant: length of internode
BJHHG604	BJHHG812	0.989	9	11: plant: position of first female flower
BJHHG221	BJHHG222	0.9885484	2	No obvious difference
BJHHG209	BJHHG222	0.986958942	4	No obvious difference
BJHHG83	BJHHG82	0.986597288	0	No obvious difference
BJHHG3	BJHHG4	0.985397942	7	24: fruit: shape of stem end
BJHHG152	BJHHG226	0.981438125	14	23:fruit: ratio of length/diameter; 37:fruit:length of yellow line on skin
BJHHG302	BJHHG304	0.981059701	9	3:plant: length of internode; 24: fruit: shape of stem end
BJHHG444	BJHHG445	0.980459063	16	3:plant: length of internode; 13:plant: number of female flowers per node
BJHHG383	BJHHG382	0.979	7	9:leaf blade: length; 21: fruit: length;27.fruit: shape of calyx end
BJHHG296	BJHHG297	0.978481836	14	21: fruit: length; 23:fruit: ratio of length/diameter
BJHHG602	BJHHG605	0.970588235	8	plant: growth type ; hypocotyl: length
BJHHG511	BJHHG509	0.9698738	8	5:leaf blade: intensity of green color; 9: leaf blade: length
BJHHG478	BJHHG479	0.965	11	21: fruit: length
BJHHG169	BJHHG170	0.94	12	6.leaf blade: shape; 8.leaf blade: dentation of margin
BJHHG478	BJHHG48	0.916843455	11	No obvious difference
BJHHG501	BJHHG502	0.787328845	5	No obvious difference

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3. APPLICATION AND PRACTICE

SSR vs. Phenotype (Tomato)

Phenotypic Variation in Tomato Variety Pairs with High Phenotypic Correlation

Sample ID	Sample ID	Phenotypic Correlation Coefficient	Total Differential Sites（SSR）	Differential Traits
FQJK2400230	FQJK2400231	0.99148216	0	No obvious difference
FQJK2400161	FQJK2400219	0.96375017	0	No obvious difference
FQJK2400160	FQJK2400162	0.973915504	0	No obvious difference
FQJK2300282	FQJK2300283	0.98083	0	No obvious difference
FQJK2300105	FQJK2300130	0.97049	0	No obvious difference
FQJK2400228	FQJK2400229	0.96261137	1	No obvious difference
FQJK2400166	FQJK2400167	0.959432416	1	No obvious difference
FQJK2400162	FQJK2400166	0.969572495	1	No obvious difference
FQJK2400162	FQJK2400164	0.960954841	1	No obvious difference
FQJK2400160	FQJK2400166	0.973496371	1	No obvious difference
FQJK2400160	FQJK2400164	0.97811117	1	No obvious difference
FQJK2400159	FQJK2400162	0.963664817	1	No obvious difference
FQJK2400159	FQJK2400160	0.966244961	1	6: Plant: growth habit
FQJK2400102	FQJK2400103	0.978696018	1	No obvious difference
FQJK2300280	FQJK2300281	0.99122	1	No obvious difference
FQJK2300143	FQJK2300190	0.95683	1	29:Fruit: size of suberized peduncle scar, 40:Fruit: glossiness of skin
FQJK2400164	FQJK2400166	0.980363635	2	8:Leaf: length, 12:Leaf: intensity of green color, 30:Fruit: depression at peduncle end
FQJK2400163	FQJK2400167	0.971922809	2	12:Leaf: intensity of green color, 14:Inflorescence: type, 24:Fruit: ratio length/diameter
FQJK2400163	FQJK2400164	0.981819137	2	No obvious difference
FQJK2400162	FQJK2400167	0.967953919	2	35:Fruit: thickness of pericarp
FQJK2400161	FQJK2400166	0.970464279	2	No obvious difference
FQJK2400161	FQJK2400164	0.975398214	2	No obvious difference
FQJK2400161	FQJK2400167	0.97323121	2	No obvious difference
FQJK2400161	FQJK2400163	0.983772111	2	24:Fruit: ratio length/diameter
FQJK2400160	FQJK2400167	0.965955824	2	No obvious difference
FQJK2400159	FQJK2400164	0.964144506	2	42:Time of maturity
FQJK2400159	FQJK2400167	0.965382436	2	No obvious difference
FQJK2400159	FQJK2400166	0.959656448	2	No obvious difference
FQJK2400139	FQJK2400164	0.968118755	2	No obvious difference
FQJK2400139	FQJK2400166	0.972182564	2	30:Fruit: depression at peduncle end, 41:Time of flowering
FQJK2400139	FQJK2400161	0.983164711	2	No obvious difference
FQJK2400139	FQJK2400219	0.966225964	2	8:Leaf: length
FQJK2400120	FQJK2400121	0.965019199	2	25:Fruit: shape in longitudinal section

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3. APPLICATION AND PRACTICE

SNP vs. Field DUS (Cucumber)

Materials: 134 major cucumber cultivars

Field DUS testing: 50 morphological traits

Laboratory SNP fingerprinting: 40 SNP markers (KASP genotyping)

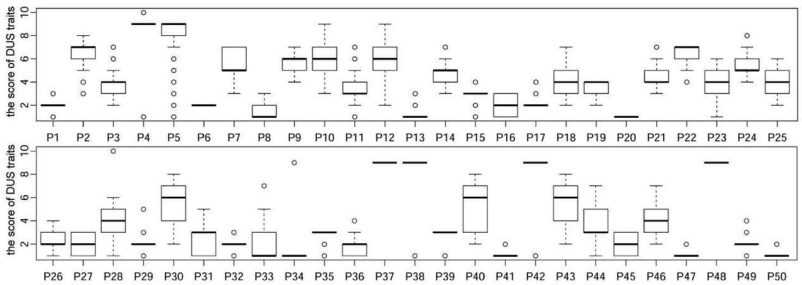

Fig. 1 Box-plots for the 50 DUS testing traits in 134 cucumber varieties

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3. APPLICATION AND PRACTICE

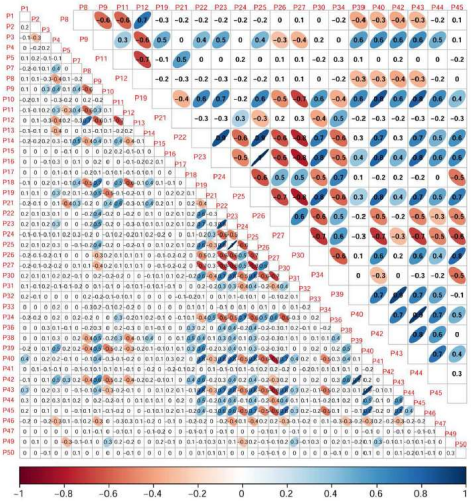

Fig. 2 Correlation coefficients among 50 DUS testing traits (lower triangle) and 20 core traits (upper triangle) for variety identification in cucumber

Table 1 The ranking of 20 core DUS testing traits

Trait ID	Trait information	PCA score
P25	Fruit: ratio of length/diameter	9.2
P42	Fruit: warts	9.1
P39	Fruit: type of bristle	8.8
P23	Fruit: length	8.6
P22	Fruit: shape	8.6
P30	Fruit: ground color of skin at market stage	8.6
P27	Fruit: shape of stem end	8.3
P43	Fruit: density of warts	8.2
P45	Fruit: color of flesh	8.1
P24	Fruit: diameter	8.0
P40	Fruit: density of bristle	8.0
P9	Plant: length of internode	7.8
P12	Plant: rate of female flower node	7.8
P19	Ovary: bristle	7.6
P34	Fruit: dots	7.4
P21	Time of beginning harvest	7.2
P44	Fruit: size of warts	7.1
P8	Plant: sex expression	7.0
P26	Fruit: shape of calyx end	7.0
P11	Plant: position of first female flower	6.6

Zhang et al., 2022. Horticultural Plant Journal, 8 (5): 575e582

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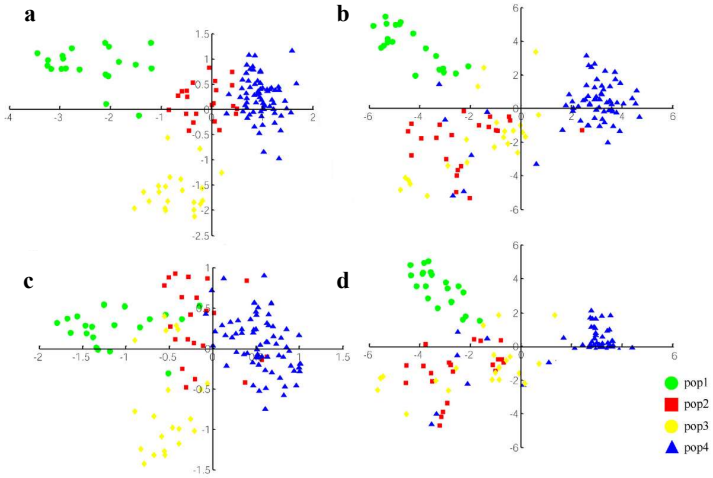
3. APPLICATION AND PRACTICE



PCA score plot of 134 cucumber varieties were respectively analyzed by 40 SNP markers (a), 46 DUS testing traits (b), 14 core SNP markers (c) and 20 core DUS testing traits (d)

Zhang et al., 2022. Horticultural Plant Journal, 8 (5): 575e582

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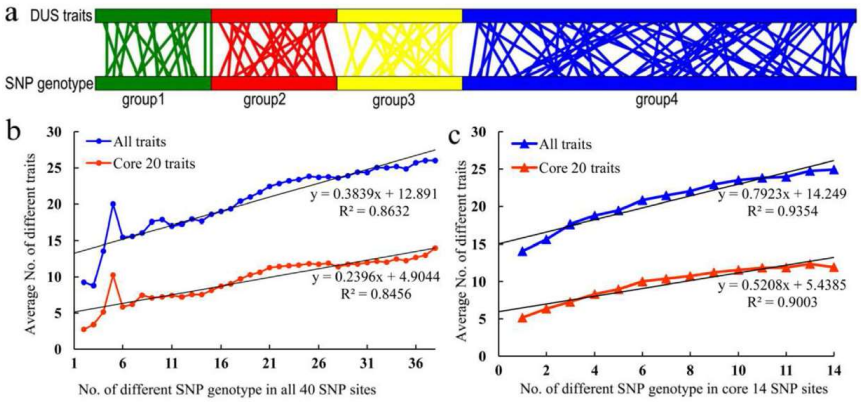
3. APPLICATION AND PRACTICE



a: Correspondence of variety identification between DUS traits (top of the figure) and SNP genotype (bottom of the figure) separately in four groups. b: Linear-related curve between 40 SNP markers and DUS traits in distinguishing each pair of varieties. c: Linear-related curvebetween 14 core SNP markers and DUS traits in distinguishing each pair of varieti

Zhang et al., 2022. Horticultural Plant Journal, 8 (5): 575e582

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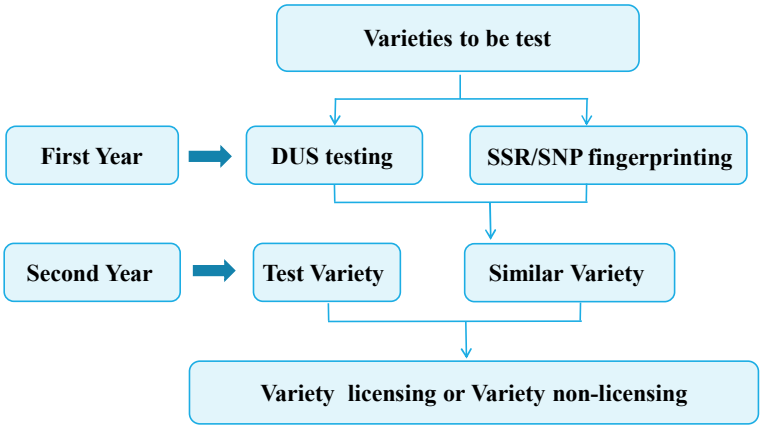
3. APPLICATION AND PRACTICE



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THANK YOU FOR YOUR ATTENTION!

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