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INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS

Geneva

WORKING GROUP ON BIOCHEMICAL AND MOLECULAR TECHNIQUES AND DNA-PROFILING IN PARTICULAR

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ADDENDUM TO DOCUMENT BMT/14/5

THE USE OF REFERENCE VARIETIES IN VARIETAL DISTINCTNESS: AN APPROACH UNDER INVESTIGATION IN THE UNITED STATES OF AMERICA FOR POTENTIAL APPLICATION IN PLANT VARIETY PROTECTION

Document prepared by experts from Monsanto Company

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The Annex to this document contains a copy of a presentation "The Use of Reference Varieties in Varietal Distinctness: an Approach under Investigation in the United States of America for Potential Application in Plant Variety Protection" made at its fourteenth session of the Working Group on Biochemical and Molecular Techniques and DNS-Profiling in particular (BMT).

Paul T. Nelson, Fred Achard, Marymar Butruille, Stevan Madjarac
Monsanto Company, St Louis, MO USA

[Annex follows]

ANNEX

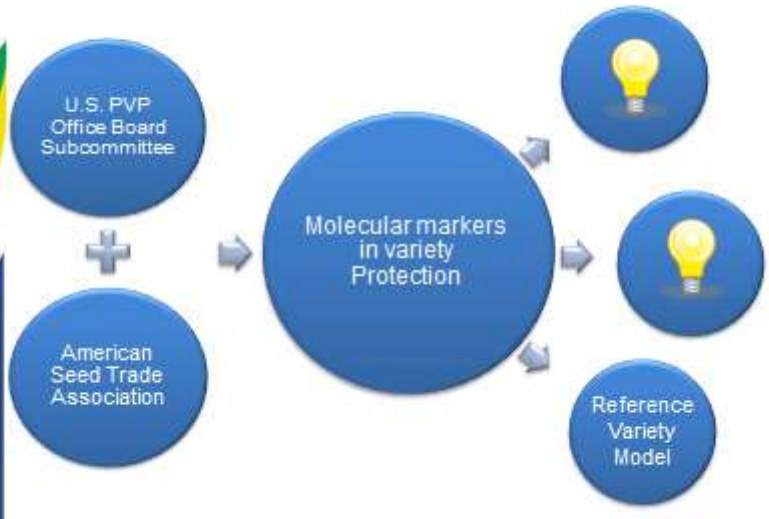
The use of Reference Varieties in Varietal Distinctness: an Approach under Investigation in the United States of America for Potential Application in Plant Variety Protection

Paul T. Nelson, Fred Achard, Marymar Butruille and Stevan Madjarac

Monsanto Company

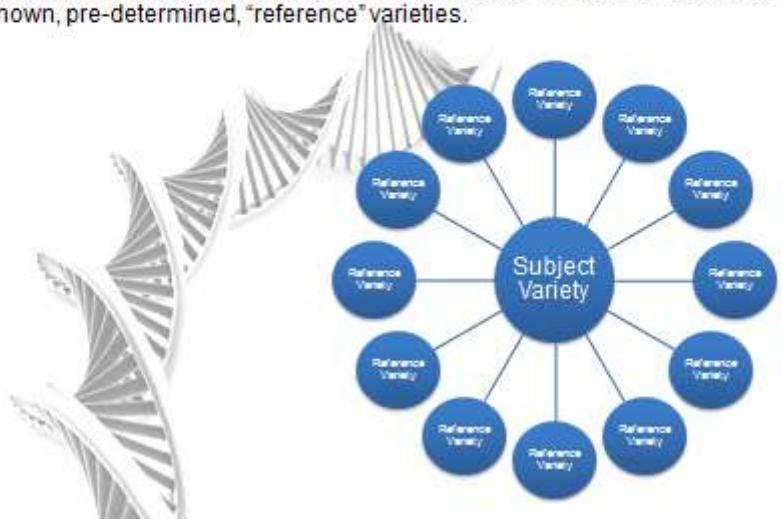
UPOV BMT 14
November 2014

Coordinated Effort



Reference Variety Model

Utilize genetic relationship between PVP candidate "subject" varieties and known, pre-determined, "reference" varieties.



Geographic Analogy

The earth's geographic coordinate system allows for precise placement of every location on earth.

U.S. Cities, Albany, Harrisburg, and Syracuse can be distinguished geographically by their coordinates, latitude and longitude:

City	Latitude	Longitude
Albany	42.6525	-73.757222
Harrisburg	40.26972	-76.875556
Syracuse	43.04694	-76.144444

Geographic Analogy

Another way to distinguish between, Albany, Harrisburg, and Syracuse is by measuring their distances from well-known 'reference' cities:

Subject City	Boston	New York	Philadelphia	Rochester	Pittsburgh
Albany	223	217	323	319	575
Harrisburg	539	248	151	327	264
Syracuse	423	314	354	120	432

(Kilometers)

Albany and Harrisburg are very similar in their distance from Rochester, but are distinguished from each other by their distances from the other cities.

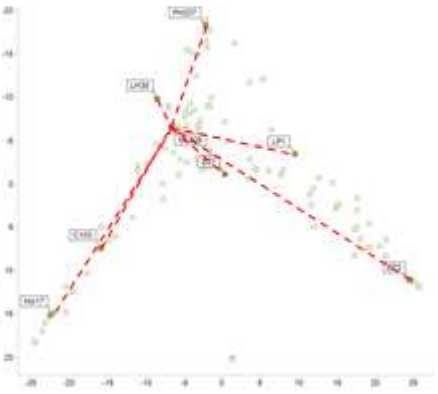
Distance Application to Genotypes

Varieties do not have fixed "coordinates".

However, genetic distances can be easily computed.

Genetic similarities coefficients, with a known set of 'reference' varieties, can be used to distinguish between genotypes.

Subject Variety	B37	B73	C103	LH38	LP1NRHt	Mo17	PH207
NK764	0.474	0.704	0.395	0.397	0.594	0.368	0.466
DK4676A	0.469	0.459	0.372	0.405	0.497	0.376	0.413
ML606	0.484	0.426	0.438	0.732	0.428	0.463	0.484
NK740	0.441	0.341	0.655	0.465	0.400	0.890	0.433
LH132	0.542	0.838	0.371	0.418	0.504	0.365	0.465
NQ508	0.549	0.444	0.428	0.462	0.479	0.445	0.643
PHT77	0.425	0.409	0.437	0.464	0.412	0.445	0.401



Distance Application to Genotypes

Genetic similarity coefficients fit nicely into the existing PVP morphological framework.

Each reference variety is treated as a new 'trait'.

PVP	Variety Name	Kernel Type	Days to 50% Silk	Heat to 50% Silk	Plant Height	Ear Height	internod e Length	No. of Tillers	No. of Ears	B37 Sim	B73 Sim	C103 Sim	LP1 Sim	Mo17 Sim	PH207 Sim
8400057	PHG71	DNT	066	1510	168	064	006	0	1.25	0.435	0.457	0.406	0.598	0.597	0.657
8000011	PR19	DNT	066	1411	175	061	012	0	1.25	0.450	0.442	0.451	0.594	0.425	0.445
8000067	LH59	DNT	065	1360	203.5	76.4	010	0	2.54	0.457	0.401	0.456	0.458	0.455	0.469
7800047	LH1	DNT	069	1625	178	066	011	0	1	0.752	0.467	0.593	0.469	0.422	0.545
8000066	LH58	DNT	062	1556	160.2	49.2	013	0	1.75	0.467	0.589	0.455	0.405	0.441	0.453
7800019	LP1	DNT	069	1520	215	106	012	1.5	1.25	0.446	0.513	0.434	1.000	0.596	0.456
7900077	Seagull-17	DNT	064	1650	170	070	012	0	1	0.444	0.551	0.650	0.406	0.965	0.455
8200062	LH51	DNT	067	1465	207	084	013	0	1	0.462	0.551	0.645	0.597	0.912	0.447
8200065	LH74	DNT	061	1344	169	072	010	1.5	1.75	0.470	0.734	0.575	0.666	0.565	0.445
8200064	LH119	DNT	062	1544	220	087	012	0	1.25	0.536	0.665	0.566	0.496	0.554	0.474
8500102	LH145	DNT	060	1294	207	082	015	0	1.25	0.449	0.479	0.449	0.705	0.409	0.449

Identification of Reference Varieties

Reference varieties must be relevant to the pool of subject varieties under consideration.

Subject City	Boston	New York	Philadelphia	Rochester	Pittsburgh	Sacramento	Fresno
Albany	225	217	325	319	575	4005	3946
Harrisburg	359	248	151	327	264	3799	3719
Syracuse	425	314	354	120	451	3806	3747
Los Angeles	4174	3940	3647	3638	3455	382	330
San Francisco	4336	4133	4055	3795	3641	120	261

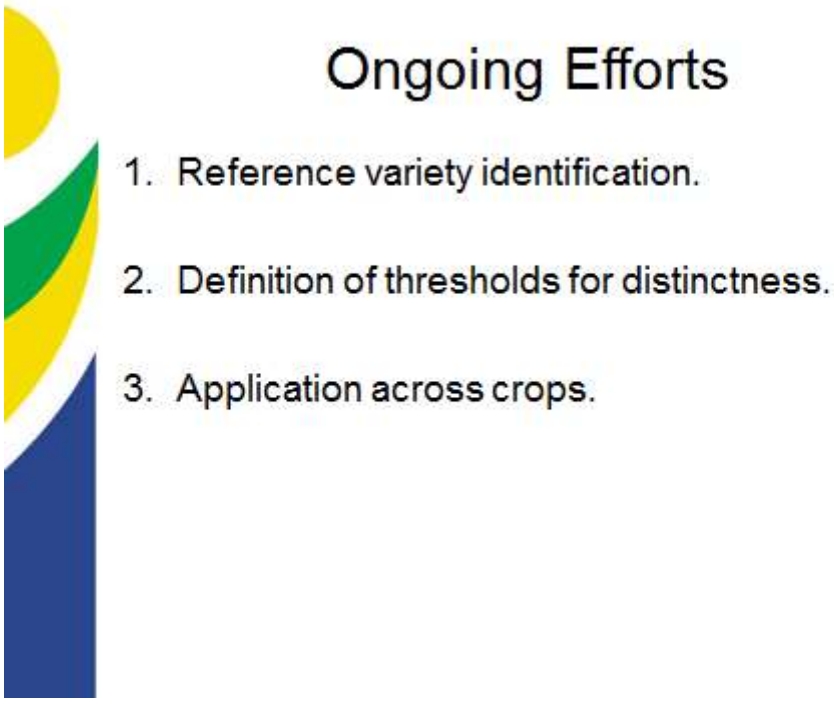
(Kilometers)

Model Limitations

- Data reduction = loss of information.
- The reference variety model will sometimes fail to distinguish between genetically distinct varieties.
    1. Fingerprints can be used to make direct variety comparisons.
    2. Morphology remains the primary means of determining distinctness by the PVPO.

Model Features

1. Simplicity in theory and computation.
2. Breeders maintain control of fingerprints.
3. The U.S. PVPO does not need to store, maintain, or safeguard fingerprints.
4. The model fits nicely into the existing PVP framework.
5. Genetic similarity coefficients do not replace existing morphological descriptors.



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