Variety Tracer
品种追踪

Application of DNA technology in the enforcement of Plant Breeders' Rights

DNA技术在育种者权利执法领域的应用

Hedwich Teunissen, Naktuinbouw R&D, IP-Key CHINA, December 2, 2020

Hedwich Teunissen, 荷兰新品办研发处，IP Key 中国，2020年12月2日

The Team 团队

molecular biologists
分子生物学家

botanists – crop specialists
植物学家 — 作物专家

Success Factors
成功因素
multi-disciplinary teams
great cooperation
between specialists
多学科团队
专家之间的良好合作

Bioinformatic experts
生物信息学专家

instructing party,
clients & legal
experts
指导方、客户及
法律专家

Applications 应用

- **Swaps/Mix-ups 互换/混合**
- **Identification issues 识别组织**
  - True-to-type QC in propagation process
  - 繁殖过程中进行纯种质量控制

- **Research in case of suspicion of fraud**
- **怀疑存在欺诈时，进行研究**
  - Suspected material is identical to protected material
  - 可疑材料与受保护材料完全一致
  - Unauthorized use of protected parental line
  - 未经授权使用受保护的亲本品系
  - Couterfeit seeds
  - 假冒种子
  - EDV
  - 实质性衍生品种

Track down fraud 追踪欺诈

ROYALTY ADMINISTRATION INTERNATIONAL®

aib For Intellectual Property Rights on Plant Material

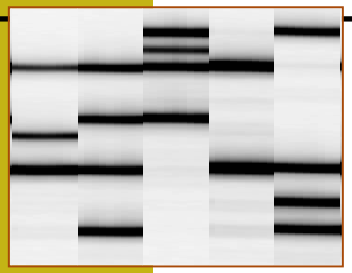
BREEDERS TRUST

Police Officers in the world of Plants

植物保护界的警察

Crime Plant Investigation
植物犯罪调查

Variety Tracer 品种追踪



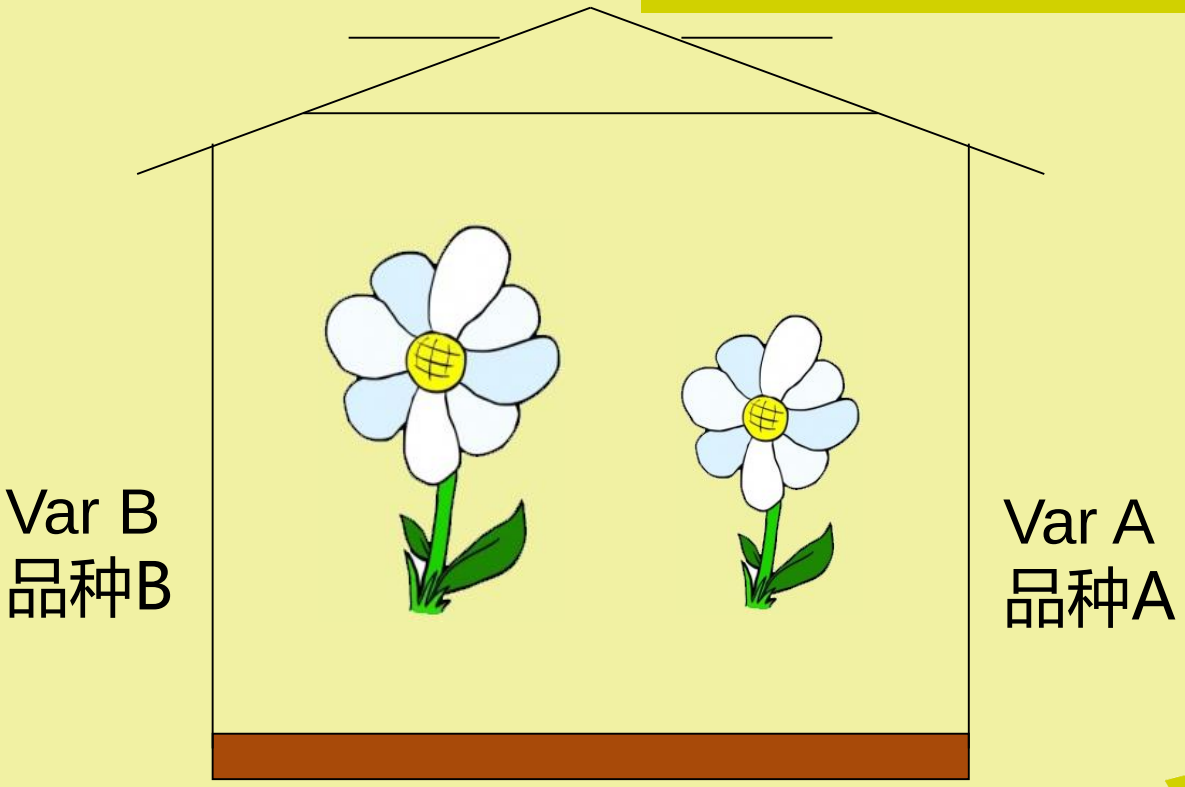
The ‘Sherlock Holmes’ concept in infringement matters

侵权追查领域的“福尔摩斯”理念

How does Variety Tracer work…
品种追踪的工作方式…

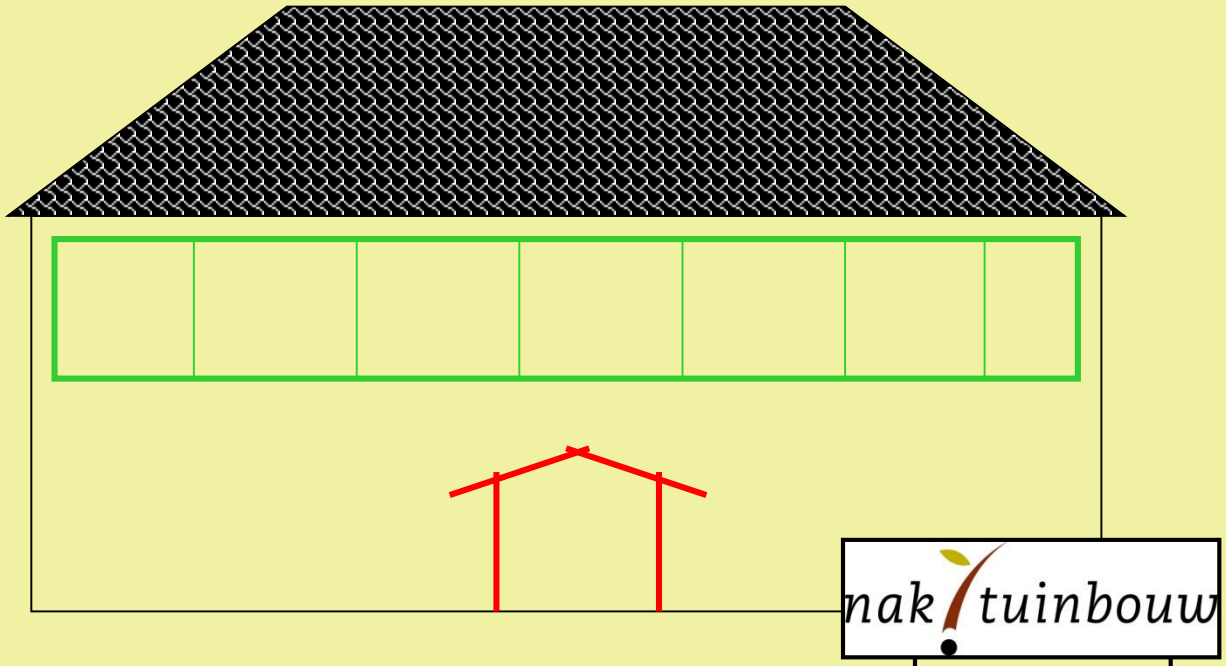
Var A = Var B
品种A = 品种B

Var A ≠ Var B
品种A ≠ 品种B

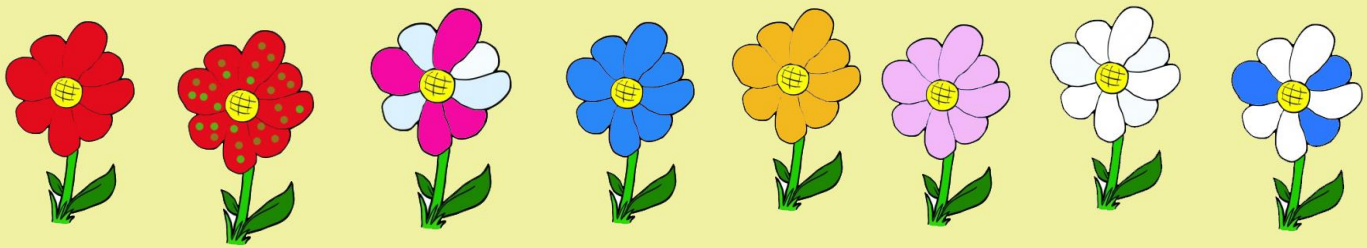


nak tuinbouw

Naktuinbouw Variety Tracer
Naktuinbouw 品种追踪



Collect reference varieties... 收集参考品种...



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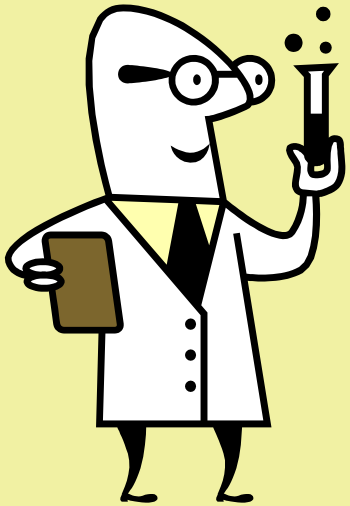
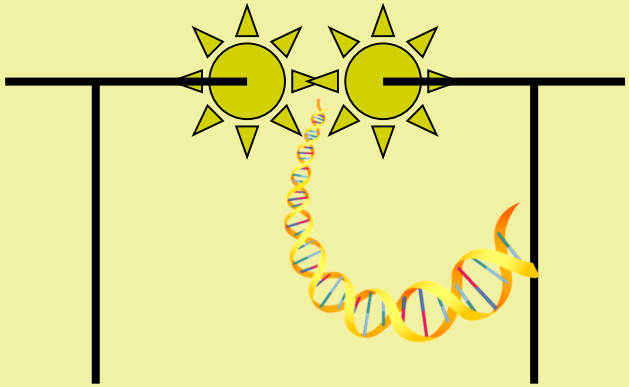
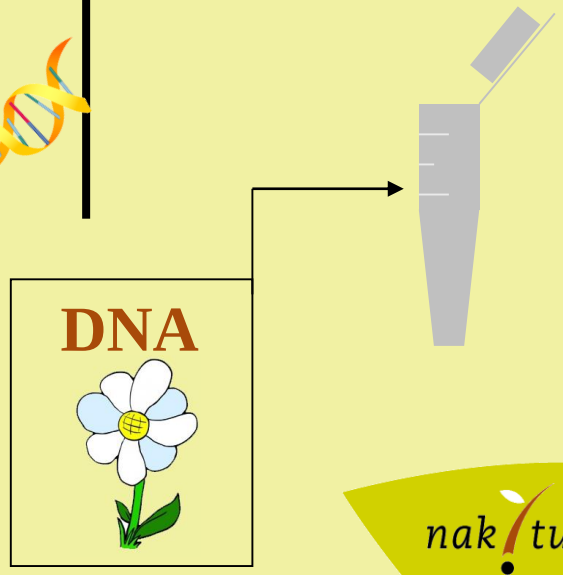
In the lab… 实验室…







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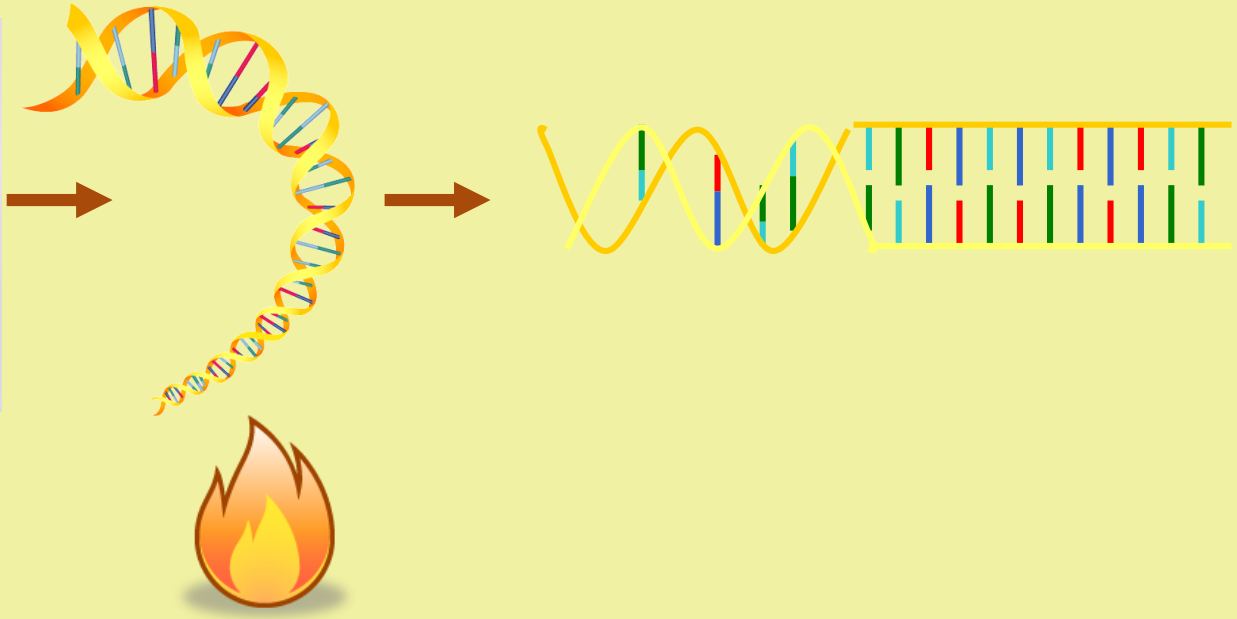
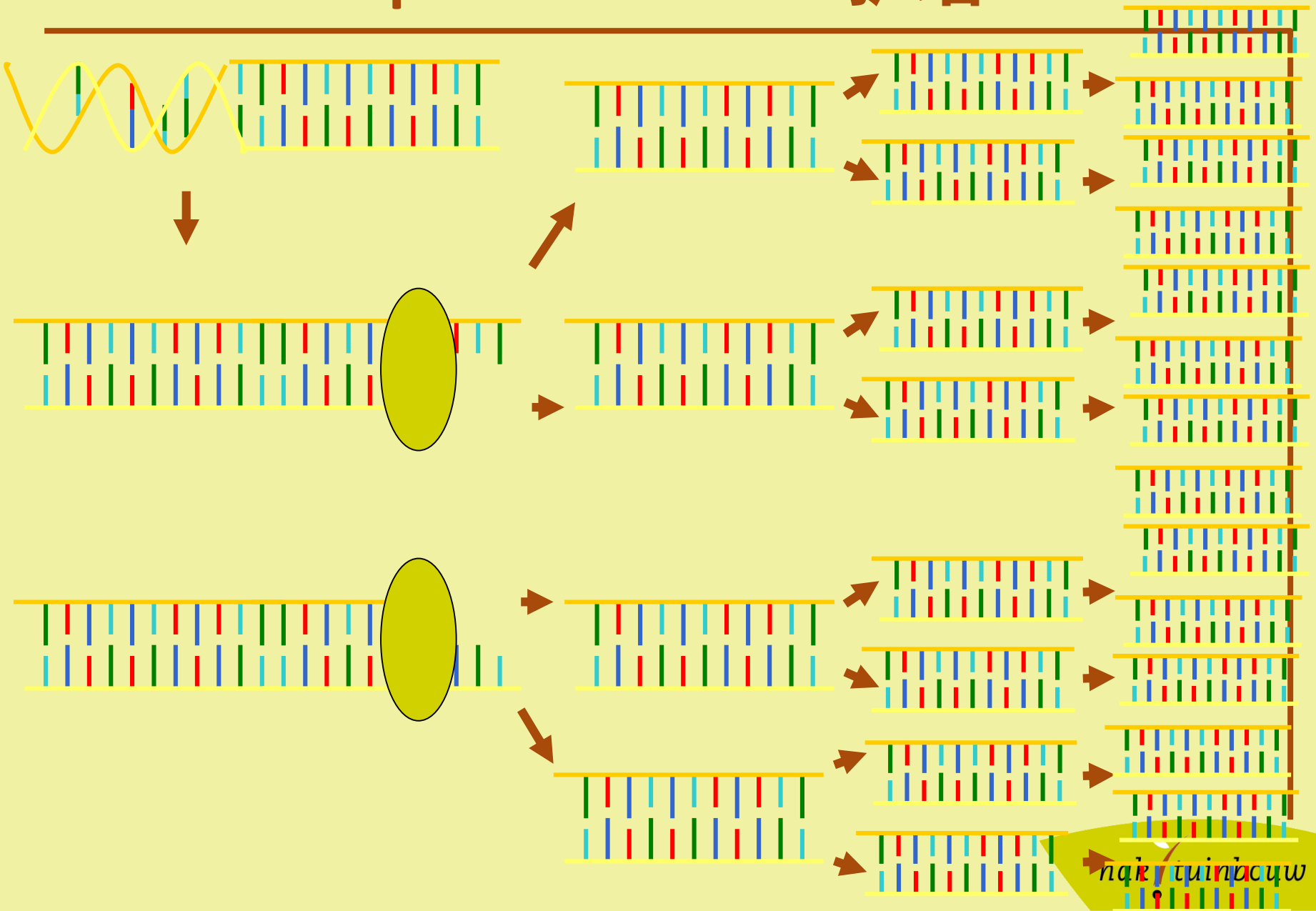
DNA profiling… DNA鉴定…



Based on PCR technology
根据聚合酶链式反应技术

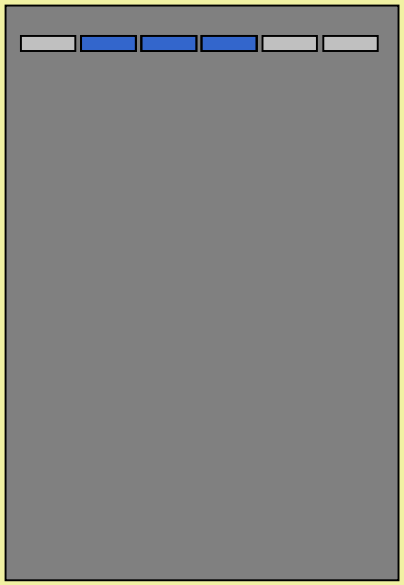
DNA multiplication...DNA扩增...

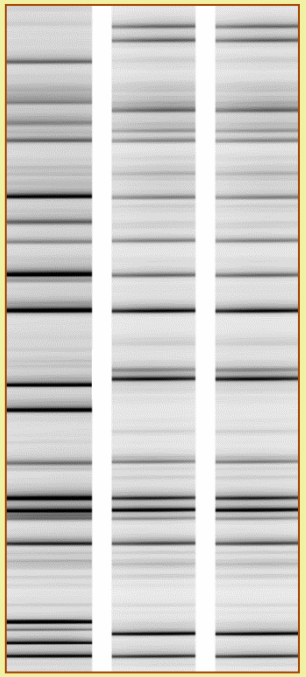


DNA visualization… DNA可视化

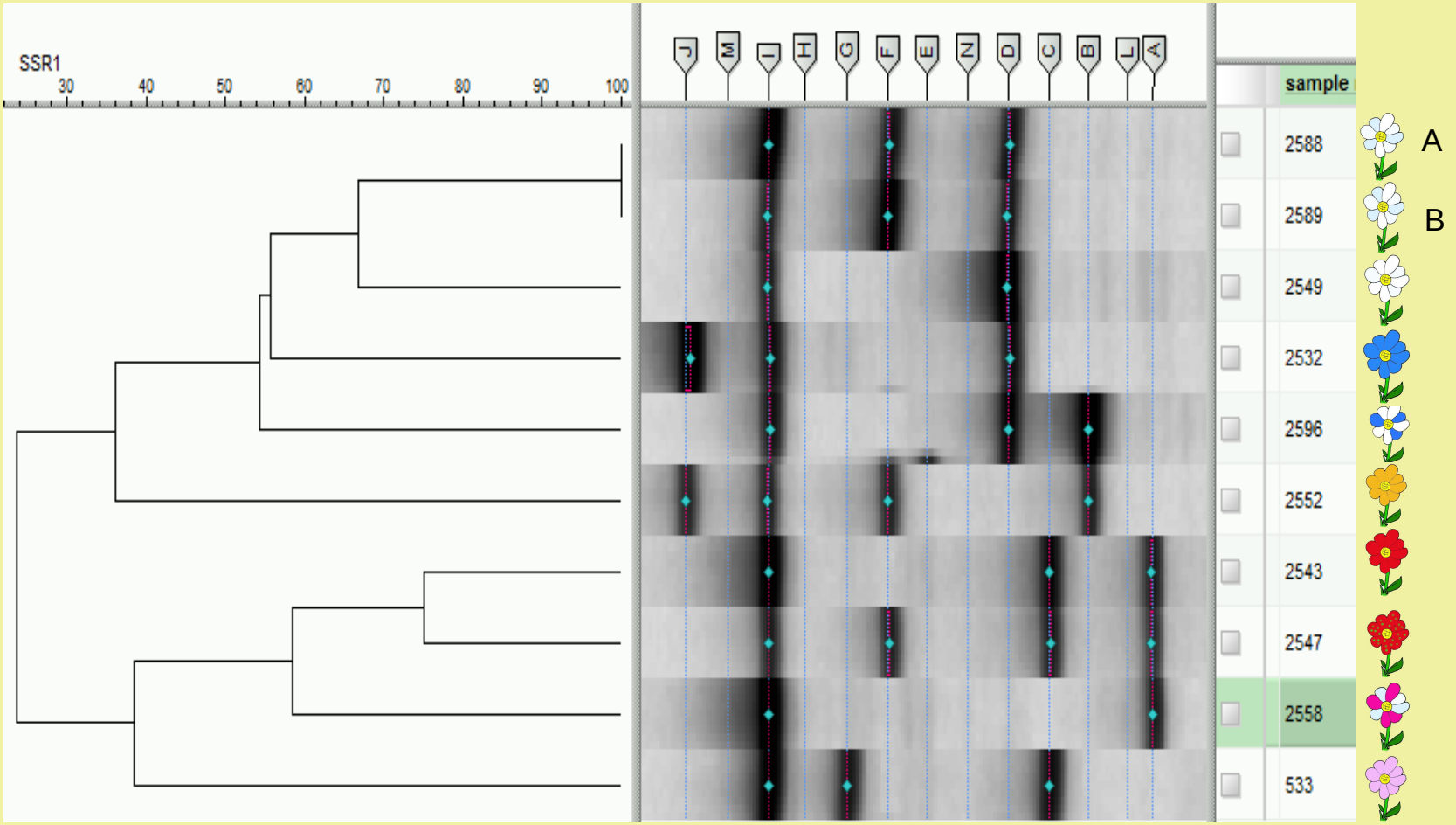
After selective multiplication of DNA, visualization on gel. DNA fragments can be separated based on size. This results in the bar-code DNA profile

对DNA进行选择性扩增后，在凝胶上进行可视化处理。可根据大小分离DNA碎片，从而产生条码型DNA图谱。



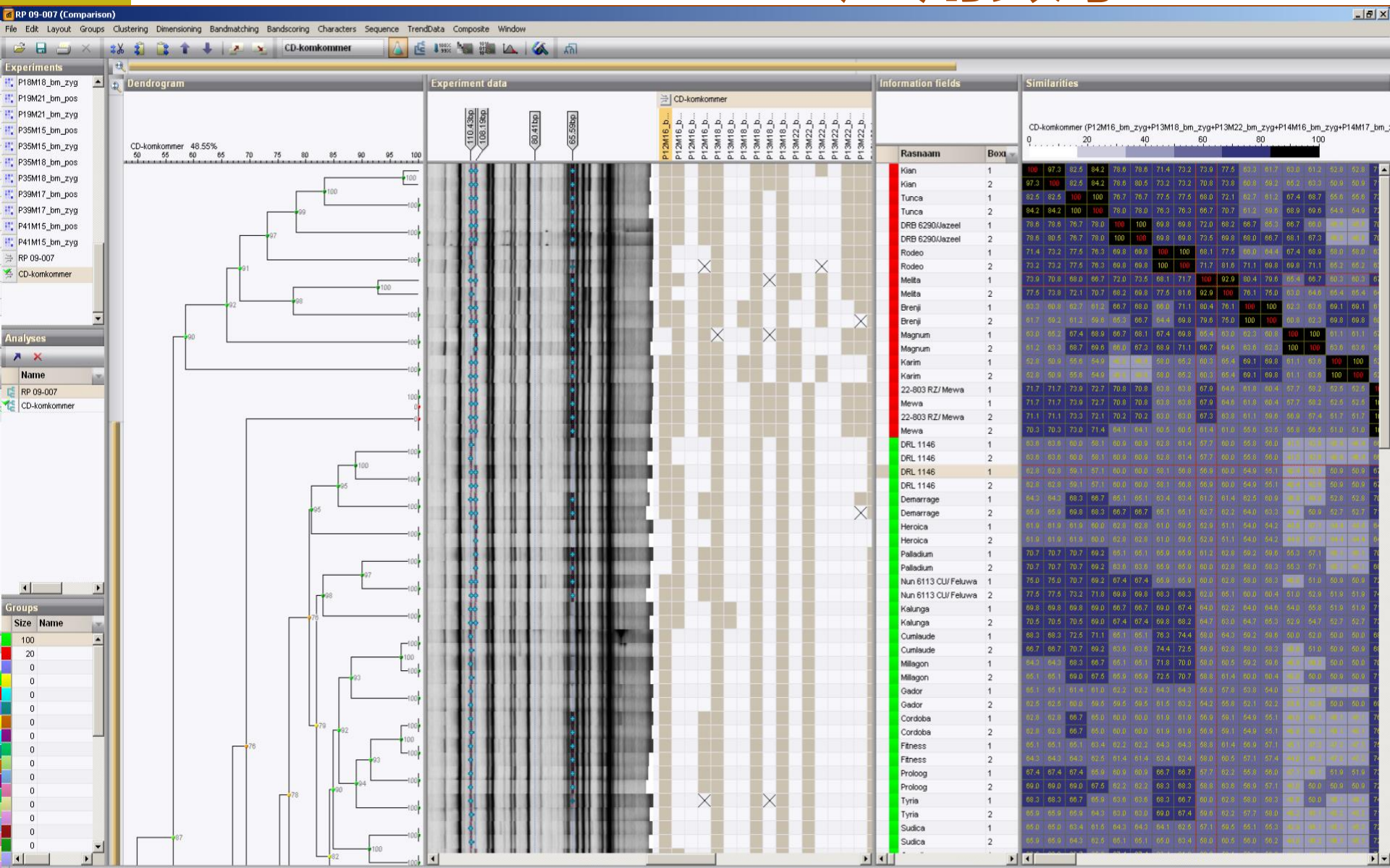


Genetic relationships… 遗传关系…



Bionumerics – Applied Maths

Bionumerics —应用数学



Every VT project is unique
每个品种追踪项目都是独一无二的

- Background information 背景信息
- Independent sampling 独立取样
- Morphologic comparative research 形态对比研究
- Genetic Research 遗传研究
- Report 报告

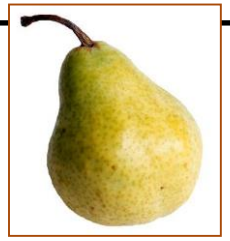
Comparing is relative 对比是相对的

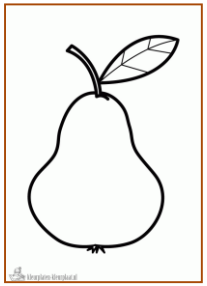
Choice of Marker Technology
How deep?
(number of markers?)
标记物选择深度?
(标记物数量？)

Choice of reference framework
How wide?
(which references are informative?)
参考范围选择宽带?
(哪些参考物是信息性的？)

Choice of reference framework
参考范围选择

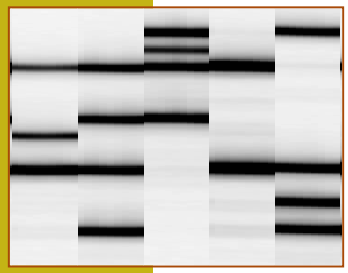
Genetic relationship?? 遗传关系?





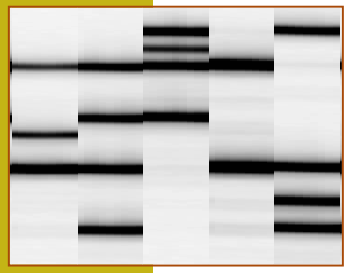
Reference framework not relevant
参考范围不相关

Selection of samples 样本选择



- Genetic width 基因宽度:
  - Reference collection representative for the morphological diversity within the genus/species.
  - 收集可代表植物属/种内形态多样性的参考样本
- Fine tune genetic similarity of known related varieties:
- 微调已知相关物品的遗传相似度:
  - Varieties that are related but not essentially derived e.g. seedlings, (half) sibs and parental lines
  - 相关但并非实质性衍生的品种，例如，秧苗、（半）姊妹品系和亲本品系
- Fine tune genetic similarity of known derived varieties:
- 微调已知衍生品种的遗传相似度:
  - Accepted mutants/derivations + original variety
  - 经认可的变异品种/衍生品中+原始品种

Selection of samples 样本选择



- Samples from the varieties in question from different origin
- 对应品种来自不同产地的样本
  - Selection and drift
  - 选择和漂移

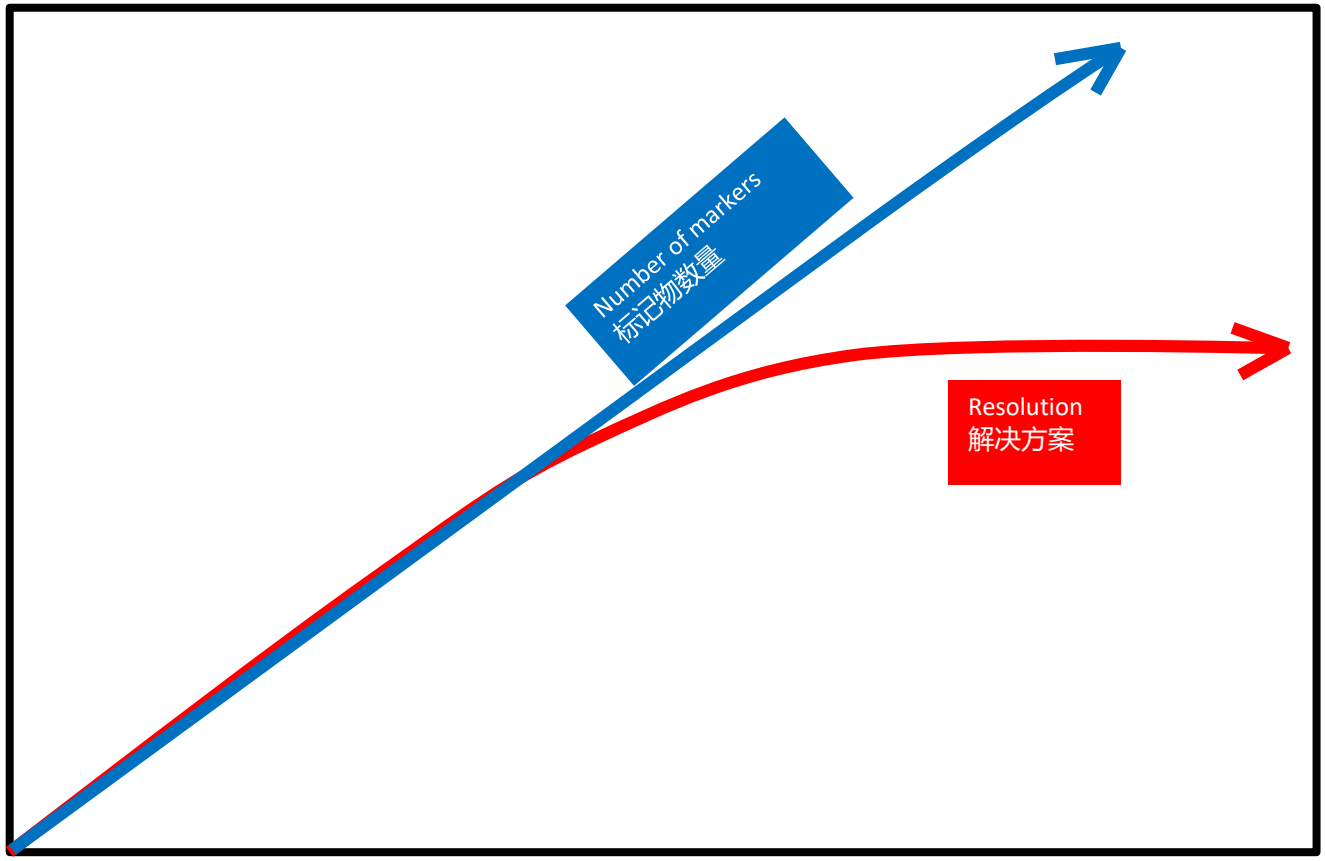
- Original identity sample (DUS application)
- 原始身份样本（特异性、一致性和稳定性测试）
- All samples *in duplo* as technical control
- 所有样本都采用双倍数，进行技术对照

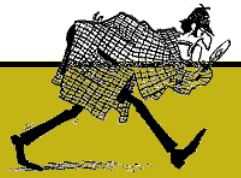
Comparing is relative 对比是相对的

Choice of Marker Technology
How deep?
(number of markers?)
标记物选择深度?
（标记物数量？）

Choice of reference framework
How wide?
(which references are informative?)
参考范围选择宽带?
(哪些参考物是信息性的？)

What resolution do we need
我们需要的解决方案





Genetic resolution - *choice of technology*
遗传学解决方案 — 技术选择

AFLP
扩增片段长度多态性
Random 随机
Generally applicable 普遍适用
Bi-allelic 双等位基因
Dominant 单显性

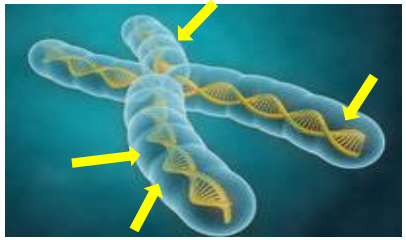
SNPs
单核苷酸多态性
Targeted 定向
Crop specific 作物特异性
Bi-allelic 多等位基因
Co-dominant 等显性

SSR 简单序列重复:
Targeted 定向
Crop specific 作物特异性
Multi-allelic 多等位基因
Co-dominant 等显性

NGS 新一代测序:
Random and Targeted 随机与定向
Generally applicable 普遍适用
Multi-allelic 多等位基因
Co-dominant 等显性

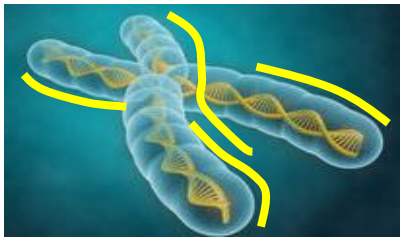
Next Generation Sequencing
新一代测序

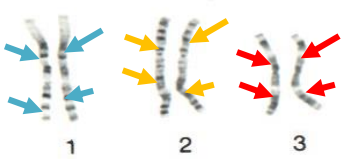
Variety Tracer 1.0
品种追踪1.0版

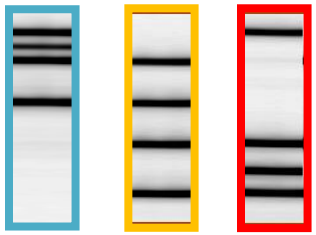


from
Variety Tracer
1.0 to 2.0
从1.0版到2.0版

Variety Tracer 2.0
品种追踪2.0版







Example from real life 实例

Harrogate
英国哈罗盖特市

现在蔬菜展也要进行欺诈检测：展会中的番茄要接受DNA测试，以确保品种正确

Now even veg shows are testing for cheats: Tomatoes in contest will have DNA examined to ensure they are correct variety

- **Harrogate Autumn Flower Show is using DNA technology to ensure a £1,000 giant tomato prize is not won by a cheating grower**
- **The show is running a Gigantomo class, with a £1,000 top prize at stake**
- **Organiser will use Dutch specialists to DNA test plants to make sure the entries are what they claim to be**
- **Winner could scoop a further £5k if heaviest fruit sets a new world record**

By DAILY MAIL REPORTER

PUBLISHED: 00:58 GMT, 8 September 2015 | **UPDATED:** 03:33 GMT, 8 September 2015

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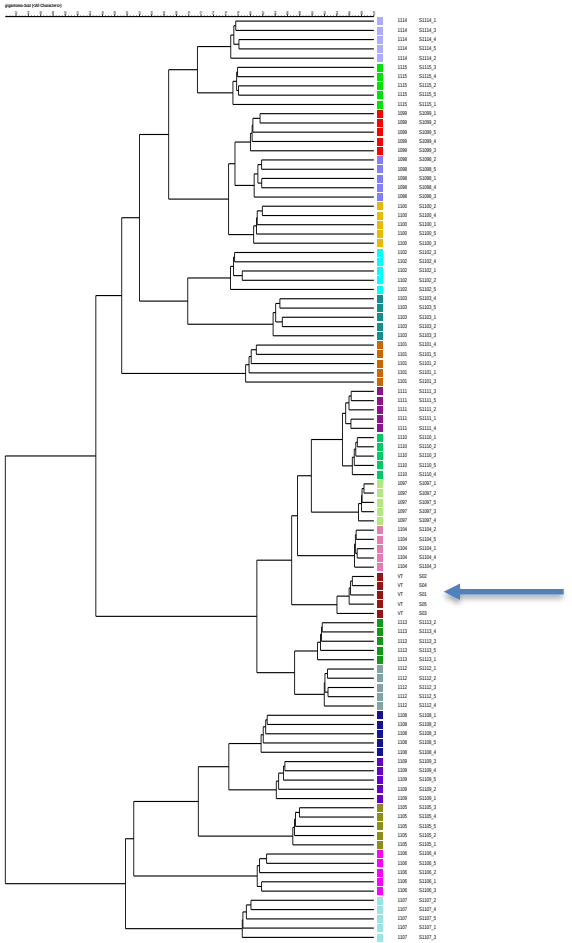
You would think a set of scales and an expert eye would be enough to judge something as genteel as a giant vegetable contest.

But the competition has grown so fierce in one picturesque town that organisers have introduced DNA testing to weed out any imposters.

Adjudicators at the Harrogate Autumn Flower Show will be relying on Dutch specialists to ensure that entries to their Gigantomo tomato class really are from that strain of the plant.

Unexpected discovery 意外发现

Sample 样品	Nr reads 读长数	Nr reads mapped 映射读长数	% mapped 映射比例
S01	14,891,765	14,691,276	98.7
S02	19,300,543	19,026,261	98.6
S03	16,093,446	6,221,944	**38.7**
S04	18,251,261	18,075,659	99.0
S05	17,633,012	17,358,359	98.4




THANK YOU

Quality in Horticulture
园艺质量