

MENDEL'S WORK WITH LAWS OF INHERITANCE – SCIENCE & TECHNOLOGY

NEWS: A global team **mapped pea genomic diversity**, advancing breeding research, revisiting Mendel's traits, and boosting sustainable agriculture.

WHAT'S IN THE NEWS?

Overview of the New Research in *Nature Journal*

a. International Collaboration

- The study is a result of collaboration between the **John Innes Centre (JIC)** and the **Chinese Academy of Agricultural Sciences (CAAS)**.
- It also involved contributions from other leading research institutes in **China, the United Kingdom, the United States, and France**.
- This collaborative effort highlights the **global importance of legumes** in modern agriculture and food security.

b. Genomic Mapping of Agronomic Traits

- Researchers successfully **mapped over 70 agronomic traits** to specific genomic regions in the pea plant genome.
- Traits include those related to **yield, disease resistance, seed characteristics, plant structure, and flowering**.
- Each trait is linked with **multiple genetic markers**, making it possible to track and select desired traits efficiently.

c. Advancement in Pea Breeding

- These genomic insights can **accelerate the breeding of improved pea varieties**, making use of **marker-assisted selection**.
- The research allows breeders to make **data-driven decisions** and improve traits through **predictive models**.
- It can potentially reduce the time required for **developing high-performing, resilient pea cultivars**.

Significance of the Study

a. Enhanced Gene Bank and Genomic Resources

- The research has expanded the **gene bank of peas**, adding **valuable genetic diversity**.
- This genomic data is now **openly available** to breeders and researchers globally.
- It will benefit not only pea breeders but also **legume research as a whole**.

b. Environmental and Nutritional Value of Peas

- Peas are seen as a key crop in the transition to **sustainable agriculture**, due to their ability to:
 - Fix atmospheric **nitrogen naturally**, reducing dependence on chemical fertilizers.

- Serve as a rich **source of plant-based protein**, important in human and animal diets.
- Promoting pea cultivation aligns with global goals for **climate-resilient and environmentally sustainable farming**.

c. Use of Artificial Intelligence in Breeding

- The integration of this genomic data with **AI models** will enable **predictive breeding**.
- AI can analyze gene combinations to predict traits like **disease resistance, yield, or plant vigor**.
- This will **revolutionize traditional plant breeding** by increasing precision and reducing trial-and-error cycles.

Mendel's Historic Experiments with Peas

a. Father of Genetics

- **Gregor Mendel**, a 19th-century monk and scientist, is considered the **father of modern genetics**.
- His work involved detailed experiments with **pea plants** and focused on how traits are inherited across generations.

b. Traits Studied by Mendel

- Mendel chose pea plants because of their **easily observable traits** and ability to be **cross- or self-pollinated**.
- He studied **seven key traits**:
 1. **Seed shape** – round or wrinkled
 2. **Seed color** – green or yellow
 3. **Pod shape** – constricted or inflated
 4. **Pod color** – green or yellow
 5. **Flower color** – purple or white
 6. **Plant height** – tall or dwarf
 7. **Position of flowers** – axial or terminal

c. Scientific Approach

- Mendel conducted **thousands of crosses over many years**, ensuring statistical robustness.
- He recorded how traits were passed from parent to offspring and derived mathematical ratios from his observations.
- His findings laid the **foundation for classical genetics** and the concept of **genes and alleles**.

Mendel's Laws of Inheritance

a. Law of Segregation

- Every individual has **two alleles for each trait** (one from each parent).

- These alleles **segregate independently during gamete formation**, meaning only one allele is passed to each gamete.
- This explains why **offspring inherit one genetic copy from each parent**.

MENDEL'S LAW OF INHERITANCE						
Seed		Flower	Pod		Stem	
Form	Cotyledons	Color	Form	Color	Place	Size
 Round	 Yellow	 White	 Full	 Yellow	 Axial pods, Flowers along	 Long (6-7ft)
 Wrinkled	 Green	 Violet	 Constricted	 Green	 Terminal pods, Flowers top	 Short ($\frac{3}{4}$ -1ft)
1	2	3	4	5	6	7

b. Law of Independent Assortment

- **Genes controlling different traits** are inherited **independently**, provided they are located on **different chromosomes**.
- For example, inheritance of **seed shape** does not affect the inheritance of **flower color**.
- This law explains the **genetic variability** and combinations seen in offspring.

c. Law of Dominance

- When two different alleles are present in an individual (heterozygous condition), the **dominant allele masks the recessive one**.
- For example, in the presence of one **tall (T)** and one **dwarf (t)** allele (Tt), the plant appears **tall**.
- This concept explains the **expression of traits** in F1 and F2 generations in Mendel's crosses.

Legacy and Relevance Today

a. Rediscovery of Mendel's Work

- Mendel's findings were largely ignored during his lifetime.
- His work was **rediscovered in 1900** by scientists like **Hugo de Vries, Carl Correns, and Erich von Tschermak**, who confirmed his conclusions.

b. Foundation of Classical Genetics

- Mendel's principles form the **basis of classical (Mendelian) genetics**, which is taught in biology globally.

- His laws continue to help explain **genetic inheritance**, used in both **basic research** and **applied breeding programs**.

c. Modern Validation and Expansion

- Modern genomics, like the recent research in *Nature*, continues to **validate and expand** on Mendel's work.
- These developments highlight the **scientific foresight of Mendel** and the **continued importance of peas** in genetics.

Source: <https://www.thehindu.com/sci-tech/science/scientists-finally-solve-the-160-year-old-problem-of-mendels-peas/article69621345.ece>