

Chimeras-Types of Chimeras

Chimeras

INTRODUCTION

A plant is said to be a chimera when cells of more than one genotype (genetic makeup) are found growing adjacent in the tissues of that plant. Variegated plants are perhaps the most common types of chimeras, and certainly the most convenient example to use in presenting the basic concept. The cells in a variegated leaf all originated in the apical meristem of the shoot, but some cells are characterized by the inability to synthesize chlorophyll. These appear white rather than green even though they are components of the same tissue system. Many important selections of foliage, floricultural, and landscape plants are chimeras. *Cornus alba* 'Argenteo Marginata', *Vinca minor* 'Variegata', *Ajuga reptans* 'Burgundy Glow', and many selections of *Hosta*, *Diffenbachia*, *Peperomia*, *Chlorophytum*, and *Saintpaulia* are but a few of the chimeras which have variegated foliage.

Chimeral plants may originate by grafting, spontaneous mutation, induced mutation, sorting-out from variegated seedlings, mixed callus cultures, or protoplast fusion

Structure

We exploit the difference between 3 types of plant chimera:

- Sectorial plant chimeras
- Mericlinal plant chimeras
- Periclinal plant chimeras

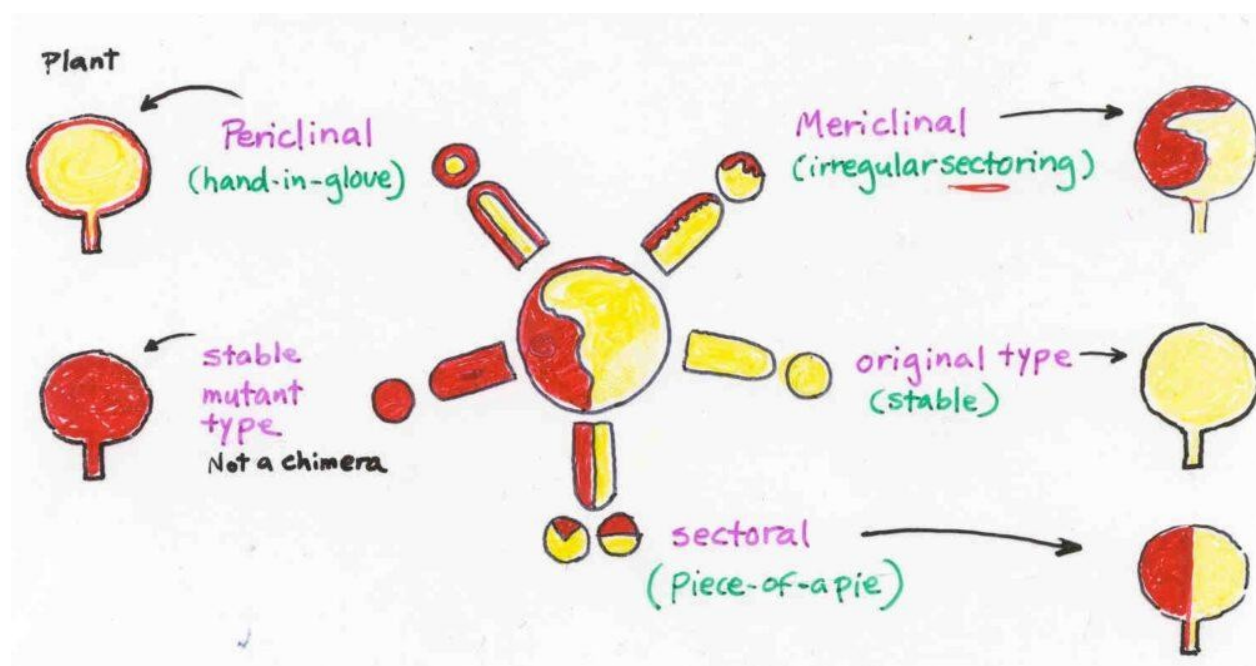
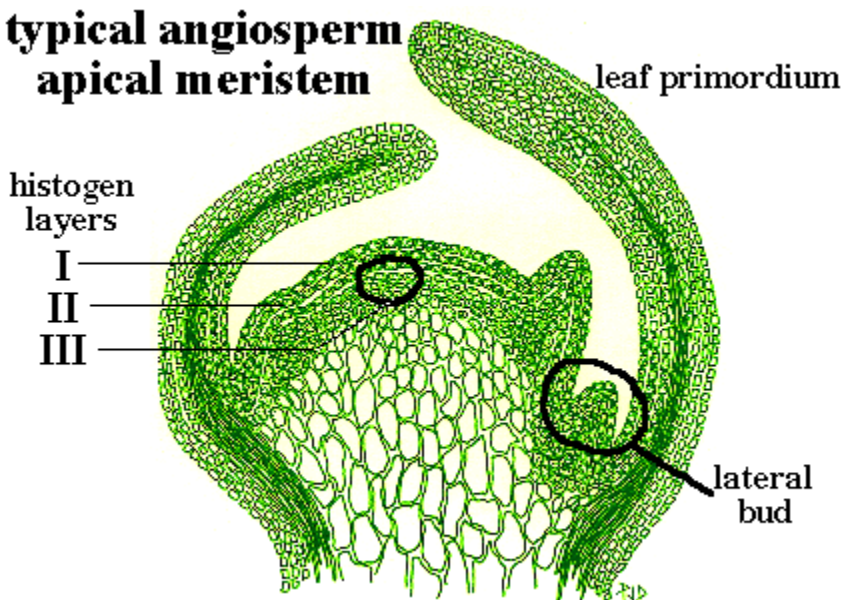


Figure 15: Different types of plant grafting chimera. Image Credit: [NDSU](#).

THE CONCEPT OF APICAL ORGANIZATION



L I give rise to the epidermis. The epidermal layer is continuous as an outer covering over all tissues of the leaf, stem, flower petals, etc. Derivatives of layer II (L.II) give rise to several layers within the stem and a large proportion of the cells in the leaf blade. Derivatives of layer III (L.III) give rise to most of the internal tissue of the stem and a number of cells around the veins within the leaf.

Chimeral Types: Periclinal, Mericlinal, and Sectorial Chimeras

Chimeral plants can be categorized on the basis of the location and relative proportion of mutated to nonmutated cells in the apical meristem. **Periclinal chimeras** are the most important category since they are relatively stable and can be vegetatively propagated. A mutation produces a periclinal chimera if the affected cell is positioned near the apical dome so that the cells produced by subsequent divisions form an entire layer of the mutated type. The resulting meristem contains one layer which is genetically different from the remainder of the meristem. If, for example, the mutation occurs in L.I, then the epidermal layer of the shoot which is produced after the mutation is the new genetic type.

A classical example of an L.I periclinal chimera is the thornless blackberry. The epidermal layer of this type produces no "thorns" (the modified epidermal cells are correctly called "prickles"). The thornless epidermis covers a stem whose cells contain the information for the thorny genotype. This can be demonstrated by taking root cuttings. The adventitious shoots which differentiate on the root cuttings are not chimeral and therefore revert to the thorny genotype.

Mericlinal chimeras are produced when the derivatives of the mutated cell do not entirely cover the apical dome. A mutated cell layer may be maintained on only one portion of the meristem giving rise to chimeral shoots or leaves which develop in that portion while those that differentiate on all other portions of the meristem are normal, nonchimeral shoots. Many mericlinal chimeras involve such a limited number of cells that only a small portion of one leaf may be affected. As was the case with periclinal chimeras, mericlinal chimeras are generally restricted to one cell layer. **Sectorial chimeras** result from mutations which affect sections of the apical meristem, the altered genotype extending through all the cell layers. This chimeral type is unstable and can give rise to shoots and leaves which are not chimeras. Both normal types and mutated types can be produced, depending upon the point on the apex from which the shoots differentiate.

Graft chimeras: *Grafting is a common technique in the propagation of plant lines. We can make graft chimeras by grafting distinct parents, cultivars or species (genetically different). The grafted individual or chimera now possesses both types of tissue. The first known graft chimera is "Bizzaria" (a fusion product of Florentine citron and the sour orange).*

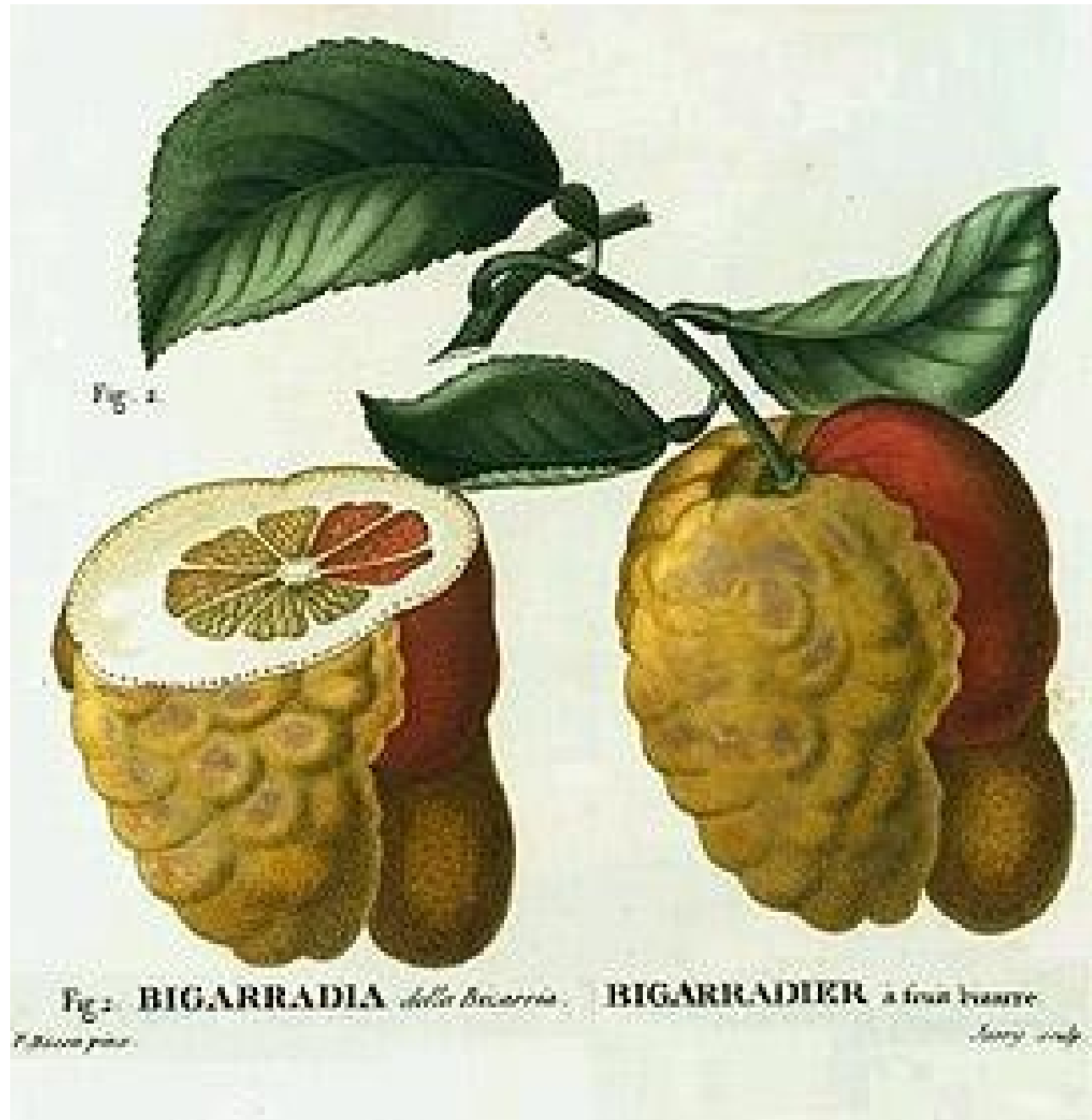


Figure 16: Bizzaria is the 1st known grafted chimera in plants. Image Credit: [Redouté, Pierre Joseph](#).

Chromosomal chimeras

Chromosomal chimeras signify different layers of plants with different chromosomal constitutions. Only occasionally, some of the chromosomal chimeras will arise following either the loss or gain of some chromosomal fragments or an entire individual

chromosome. This happens because of “misdivision”. This way of chimerism affects cell sizes and cell growth features.

Nuclear gene-differential chimeras

Nuclear gene-differential chimeras are the ones that arise when a spontaneous mutation or an induced [mutation](#) happens in one or more nuclear genes.

Plastid gene-differential chimeras

Plastid gene-differential chimeras are the ones that arise when a spontaneous mutation or an induced mutation happens in one or more plastidial genes. This is immediately followed by vegetative growth. Vegetative growth is accompanied by the separation of the two kinds of [plastids](#).

Origins

The origin of plant chimerism arose many years back. The first known record is of a graft chimera between sour orange (*Citrus aurantium*) and citron (*Citrus medica*).

Detection

Detection methods for plant chimeras:

- Reporter gene GUS
- Reporter gene Green Fluorescent Protein (GFP)
- Quantitative PCR