THIS IS PROPAGATION
By These Methods Our Plants are Multiplied

1. A “perfect” flower with both male and female parts;
2. seed
3. softwood cutting
4. half-ripe cutting
5. hardwood cutting
6. leaf-bud cutting
7. root cuttings
8. bulb
9. bulblets
10. corm
11. tuberous root
12. tuber
13. sucker
14. simple layer
15. tip layer
16. pot layer or marcot
17. air layer or Chinese layer
18. mound layer
19. graft, whip and tongue
20. graft, cleft
21. graft, side
22. budding
23. inarching – a frequent natural graft

Not illustrated: division, leaf cutting, tissue culture (micropropagation).

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TYPES OF PROPAGATION

SEXUAL
MALE AND FEMALE CELLS JOIN AND SEEDS ARE PRODUCED

ASEXUAL
1. DIVISION
   a. rhizomes
   b. tubers
   c. stolons
   d. crowns
   e. offsets
2. CUTTINGS
   a. root
   b. stem
   c. leaf
   d. leaf-bud
3. SEPARATION
   a. corms
   b. bulbs
4. LAYERING
   a. tip
   b. mound (stool)
   c. simple
   d. air
5. GRAFTING
   a. whip
   b. root
   c. cleft
   d. bark
   e. bridge
6. BUDDING
   a. chip
   b. patch
   c. t-
   d. ring
METHODS OF PLANT PROPAGATION

I. Seed (sexual)
   A. Propagation by seed - annuals, biennials, and many perennials
   B. In vitro culture systems
      1. Microspore and pollen culture – tobacco, Datura
      2. Ovule culture – carnation, tobacco, petunia
      3. Somatic embryogenesis – conifers
      4. Seed culture – orchid
      5. Spores – ferns

II. Apomictic (asexual)
   A. Seed
      1. Nucellar embryos – citrus, mango
      2. Adventitious embryony – Kentucky bluegrass

III. Vegetative (asexual)
   A. Propagation by cuttings
      1. Stem cuttings
         a. Hardwood – fig, grape, crapemyrtle, rose, willow, poplar
         b. Semihardwood – lemon, Camellia, holly, rhododendron
         c. Softwood – lilac, forsythia, weigela, crapemyrtle
         d. Herbaceous – geranium, coleus, chrysanthemum
      2. Leaf cuttings – Begonia rex, African violet
      3. Leaf-bud cuttings – blackberry, hydrangea
      4. Root cuttings – red raspberry, horseradish, philox
   B. Propagation by grafting
      1. Root grafting
         a. Whip graft – apple and pear
      2. Crown grafting
         a. Whip graft – Persian walnut
         b. Cleft graft – camellia
         c. Side graft – narrow-leaved evergreens
      3. Top grafting
         a. Cleft graft – various fruit trees
         b. Saw-kerf or notch graft – various fruit trees
c. Bark graft – various fruit trees  
d. Side graft – various fruit trees and conifers  
e. Whip graft – various fruit trees

C. Propagation by budding
   1. T-budding – stone and pome fruit trees
   2. Patch budding – walnut and pecan
   3. Ring budding – walnut and pecan
   4. I-budding – walnut and pecan
   5. Chip budding – grape, mango, fruit and ornamental trees

D. Propagation by layering
   1. Tip – trailing blackberry, black raspberry
   2. Simple – honeysuckle, spirea, filbert
   3. Trench – apple, pear, cherry
   4. Mound or stool – apple, gooseberry
   5. Air – India rubber plant, lychee
   6. Compound or serpentine – grape, honeysuckle

E. Propagation by runners – strawberry

F. Propagation by suckers – red raspberry, blackberry

G. Separation
   1. Bulbs – hyacinth, lily, narcissus, tulip
   2. Corms – gladiolus, crocus

H. Division
   1. Rhizomes – iris, banana
   2. Offsets – pineapple, date palm
   3. Tubers – Irish potatoes
   4. Tuberous roots – sweet potato, dahlia
   5. Crowns – everbearing strawberry, phlox

I. In vitro culture systems
   1. Shoot-tip culture
   2. Adventitious shoot formation
   3. Micrografting
   4. Tissue and protoplast culture
      a. Organogenesis
      b. Somatic embryogenesis