Food and Agriculture Organization of the United Nations

STRENGTHENING THE FOUNDATION FOR A SPECIALTY COCOA SECTOR IN THE CARIBBEAN

FACT SHEET

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PROPAGATION METHODS IN COCOA

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Cocoa is commonly propagated through three primary methods: seedlings, stem cuttings, and grafting. Each of these techniques offers distinct advantages and disadvantages.

Before starting any propagation endeavor, it is essential to plan carefully and ensure that all necessary facilities, equipment, and materials are in place for the process. Proper preparation will help ensure the success of the propagation and facilitate smooth operations.

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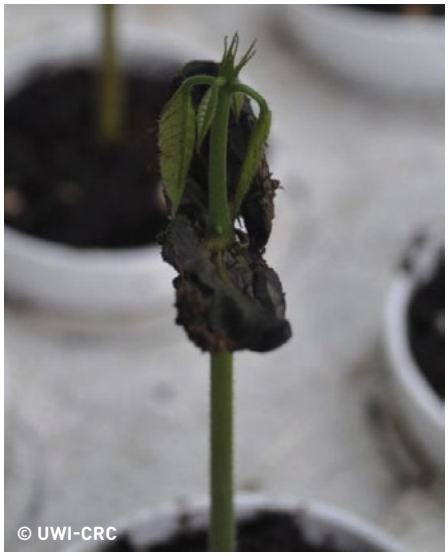
Greenhouse for cocoa propagation

SEEDLINGS



Cocoa seedling

Seedlings, derived from seeds that occur naturally or are selected through natural processes, can also be intentionally produced through hand pollinations between carefully chosen parent plants in the context of breeding or pre-breeding programs.

The primary benefit of seedling production lies in its capacity to generate large quantities of plants rapidly and economically, without the need for specialised expertise. Additionally, seedlings possess a taproot system, which affords superior anchorage and stability. However, the principal drawback of seedlings also serves as a potential advantage. Given that cocoa seedlings exhibit significant genetic variability, they are inherently diverse, a trait that can be crucial in mitigating the effects of climate change or the introduction of diseases into a given region, thus preventing widespread devastation. On the other hand, this genetic variability often leads to variations in yield and maturation time, which can detract from overall field productivity, as individual trees may not meet the expected performance of their parent plants.

When propagating by seeds, plump, healthy seeds are collected from ripe pods, while small, flat, or underdeveloped seeds are discarded. The seeds are then washed with sand or lime, followed by pre-germination or shallow planting in a suitable growing medium. For more uniform germination, beans can be peeled (removing the seed coat and pulp) and planted with the hypocotyl facing down into the medium. Seedlings are regularly watered, fertilised, and treated with pesticides as necessary.

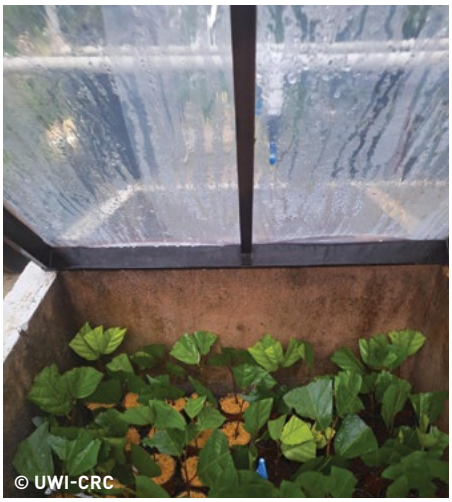
STEM CUTTINGS

Stem cuttings are typically taken from mature, fruit-bearing trees, which results in plants with a reduced bearing age. Additionally, trees produced from cuttings are genetically identical to the parent tree. The propagation of varieties that root easily can be done quickly and without the need for specialised skills. However, there are some drawbacks to using stem cuttings for propagation. One disadvantage is the lack of a tap root, which can impact the tree's growth and stability. A solution to the absence of a tap root is to use orthotropic shoots (chupons) branches for propagation instead of plagiotropic (fan) branches, as chupons produce tap like roots initially and have a more upright growth. Furthermore, the ability of stem cuttings to root can vary depending on the genotype; some cocoa varieties root more easily than others. Propagating cocoa through stem cuttings also requires higher capital investment and infrastructure to create the appropriate conditions (humid, cool and shaded) for root induction.

Chupon with spiral arrangement of leaves

Rooted fan branch cutting

Fan branch with alternate leaf arrangement



Propagation bins

PROCESS OF ROOTING CUTTINGS

- Harvest healthy semi-hard cuttings - green to green brown stems, fully expanded firm leaves (10"-14")
  - Ensure cuttings are kept cool and moist, best time to propagate cuttings is early in the morning
  - Selected stem size for cuttings: "pencil thickness"
- Remove basal leaves, prune about 2/3 to 3/4 of top leaves (3-4)
- Cut to 8"-10" long using a slanted cut
- Apply rooting hormone to base of stem
- Make a hole in medium (Coco Peat, Pro-mix, stone) then insert cutting
- Cuttings are left in the bins for 2 to 3 months
- Mist cuttings four times daily for 4 to 5 minutes
- In 5-8 weeks, when some are showing shoots, start gradually opening propagation bin and/or decrease irrigation (hardening)
- Remove dead leaves from bins on a fortnightly basis
- Fertilise with foliar fertiliser once a week
- Fertilise with two to three granules of Blaukorn once a month until transplanting
- After hardening, transplant into bigger pots containing a top soil, sand and manure medium
- Water plants immediately after transplanting

Cuttings being dipped in liquid rooting hormone

Cuttings being dipped in powder rooting hormone

GRAFTING

Grafting is the process of combining parts from two or more organisms. In cocoa, grafting is typically done on a seedling (rootstock), resulting in grafted plants with a tap root system. The selected material, known as the scion, retains all the characteristics of the parent plant. The reasons for grafting include the treatment of damaged or old plants, changing varieties, improving pest resistance, drought tolerance, compatibility, and yields. Grafting is also used for virus indexing.

However, there are some limitations to grafting, including the need for skilled personnel and the management of the rootstock to prevent it from becoming dominant.

Preferred rootstock characteristics include a vigorous root system, disease resistance (such as resistance to ceratocystis wilt), and overall health. The size of the rootstock depends on the grafting method used and the size of the available scion. The selected scion should be free from pests and diseases, with fully expanded and firm leaves, and stems that are green to green/brown in colour. Collected scions should be labelled and stored in a cool, moist and shaded environment until they are ready for use.

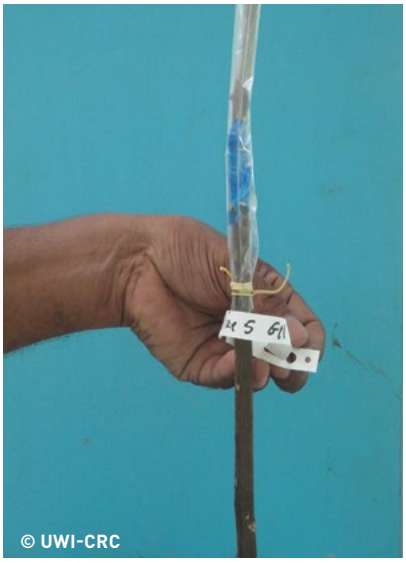
Wedge and side grafts are two commonly used techniques in cocoa grafting. When grafting, it is essential to use sharp, clean equipment. For traditional grafting, select a vigorous rootstock that is at least three months old, with a stem thickness similar to that of a pencil. It is recommended that knives and secateurs be disinfected with 70 percent ethanol before use.

Prepared scion material from fan branches with green/brown stems

Wedge graft

- **Prepare the rootstock**: Cut the rootstock horizontally at the point where the scion and rootstock will align. Ideally, this should be done where the cambium layers of both plants will meet.
- **Prepare the rootstock cleft**: Split the top of the stem vertically down to a depth of ¾" to 1½".
- **Select scions**: Choose scions with four to six buds. The scions should be healthy and appropriately sized for grafting.
- **Shape the scion**: Make two smooth, opposing 1" tapering cuts on the scion, aiming to retain a bud on the wedge.
- **Insert the scion**: Carefully insert the wedge-shaped scion into the cleft of the rootstock, ensuring the cambium layers of both parts align as closely as possible.
- **Secure the graft**: Wrap the union tightly with a rubber band or grafting tape to hold the scion and rootstock together.
- **Enclose the graft**: Place the scion inside a plastic sleeve or bag to maintain humidity and warmth. Seal the bottom of the bag tightly to make it watertight.
- **Control condensation**: If it's rainy or too humid, nip (cut) the base of the sleeve or bag to allow excess condensation to escape.
- **Label the grafted plant**: Make sure to label the grafted plant so you can track its progress.
- **Remove the sleeve**: After about 14 days or once you notice the bud break, carefully remove the plastic sleeve or bag.
- **Remove grafting tape**: At least 14 days after removing the sleeve, carefully remove the grafting tape. This is essential to avoid girdling, which can cut off the flow of nutrients and water, potentially damaging the plant.

Top graft: Making a cleft on rootstock



Top graft: Scion covered with plastic tubing to prevent it from drying out

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Top graft: Inserting scion into rootstock

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Top graft: Bud break

Side graft

- **Make 20° cut on rootstock:** Use a sharp knife or pruning shears to cut the rootstock at a 20° angle. This angle helps in creating a good surface for the scion to attach properly.
- **Select scions:** Choose scions that have four to six healthy buds. Ensure they are appropriately sized for the rootstock you're working with.
- **Shape scion base into wedge:** Use a knife to carefully shape the base of the scion into a wedge with unequal cuts. This wedge shape helps in aligning the scion with the rootstock and provides a larger surface area for grafting.
- **Insert scion into rootstock:** Gently insert the shaped scion into the rootstock, ensuring that the longer cut face of the scion is facing the rootstock for proper alignment and optimal cambium contact. Make sure the cambium layers—the thin green layer just beneath the bark—of both the scion and rootstock are aligned as closely as possible to ensure successful grafting.
- **Wrap graft with tape:** Wrap the graft area securely with grafting tape. Start from below the graft and work your way up, making sure the tape holds the scion in place and protects the graft from drying out.
- **Protect scion with sleeve or bag:** Place a protective sleeve or plastic bag over the graft to maintain humidity and warmth, which helps with the grafting process.
- **Remove the sleeve**: After about 14 days or once you notice the bud break, carefully remove the plastic sleeve or bag.
- **Remove grafting tape**: At least 14 days after removing the sleeve, carefully remove the grafting tape. This is essential to avoid girdling, which can cut off the flow of nutrients and water, potentially damaging the plant.

Side graft: Preparing scion

Side graft: Inserting scion into rootstock

Side graft: Wrapping union

Side graft: Scion covered with plastic tubing to prevent it from drying out

Young shoots on side graft

Propagation of seedlings for rootstock

AFTER CARE

During and after grafting, keep plants in a shaded area. Water carefully to avoid forceful direct splash onto the graft union and indirect splash from soil. Once the second flush has hardened, move plants to less shaded area to encourage growth and hardening.

Fertilise plants with a foliar fertiliser every two weeks, and apply a granular fertiliser every two months. Pesticides to be used as necessary and plants are to be transplanted into larger pots or bags before roots become root bound (constricted in pot).

Grafts to remain in the greenhouse for three to six months before field planting.

CONCLUSION

Understanding the different cocoa propagation methods—seedlings, stem cuttings, and grafting—helps farmers select the most suitable method for their goals. Whether seeking genetic diversity, better root anchorage, improved yield, or disease resistance, each method of propagation provides unique benefits.

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