

Accelerated value chain development (AVCD) program Root crops component



Production of apical cuttings of potato

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Introduction to apical cuttings

Apical cuttings are rooted transplants produced in a screenhouse from tissue culture plantlets. Rather than allowing tissue culture plantlets to mature and produce minitubers, cuttings are produced from the plantlets. Once rooted, the cuttings are transplanted into the field to produce seed tubers (Fig 1).

Figure 1. Cutting almost ready for transplanting (left), and soon after transplanting rooted cuttings in nursery beds in the field (right).



Key to productivity of cuttings

Apical cuttings are an alternative to minitubers in current production seed systems for potato. While minitubers are more versatile – they can be stored until ready to plant and are easy to transport, productivity of cuttings to produce seed tubers surpasses that of minitubers and are profitable after two seasons of multiplication, whereby seed produced from minitubers requires 3-4 seasons of multiplication to be profitable.

Ensuring productivity of cuttings depends on:

- using only tissue culture plants as mother plants, do not use sprouts or stems from tubers, these are stem cuttings,
- producing cuttings when it is warm, time between shoots is significantly less the warmer the temperature, night time temperatures greater than 10°C and daytime less than 30°C,
- maintaining the juvenile stage of the mother plants is key to retaining productivity of producing cuttings, and the transplants in the field to produce seed tubers, whereby the mother plant remains in a state with simple leaves (Fig. 2).



How it works

The first rounds of cuttings expand parent material in the first months of production with the remaining months dedicated to commercial production of rooted cuttings. Mother plants are produced up to ~ 3-4 weeks until the first cuttings will be planted in the field. Thus, any new shoots forming after this cut off-time will be placed into plugs for transplanting – the commercial product which will continue to be produced over a 2-4-month period.

Thus, apical cuttings involve:

- i) production of rooted cuttings (transplants) originating from tissue culture plantlets in the screenhouse
- ii) production of seed tubers in the field from transplants (Fig. 3).

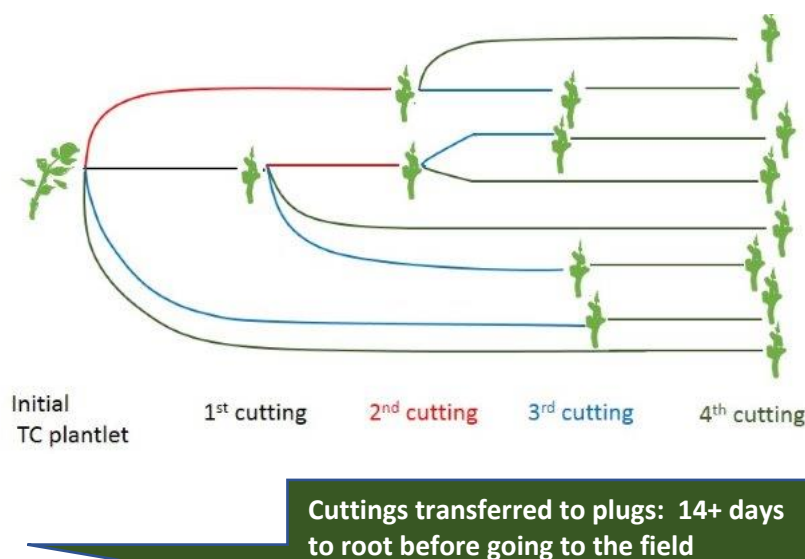
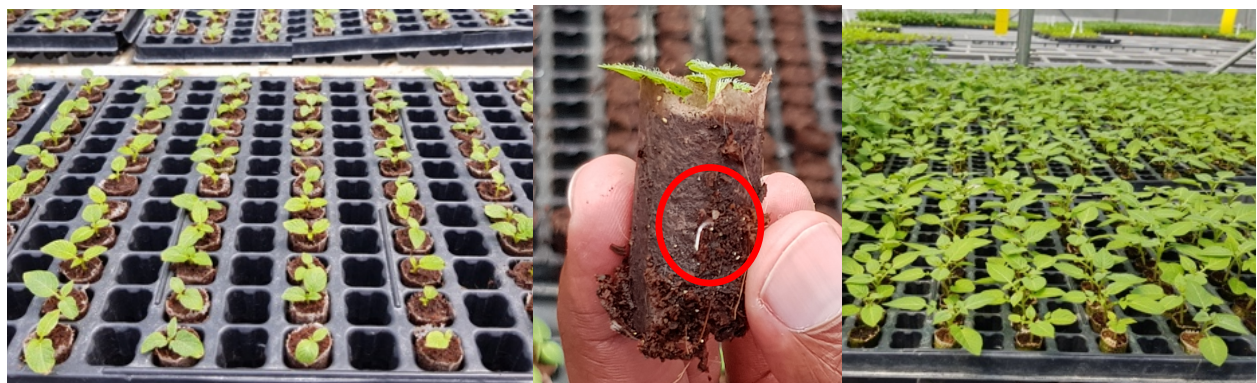


Figure 3a. Production of mother plants. 90+ days to produce pool of 15+ mother plants ready to produce rooted cuttings for transplanting.

The diagram is simplified assuming a linear propagation rate with each mother plant giving rise to one shoot (or stem) at a time. In reality, after cutting the apical tip from the cutting, each mother plant provides 1-3 shoots for cuttings.



All new stem produced by pool of mother plants placed in plugs

Roots starting to develop

Figure 3b. Production of rooted cuttings. Shoots produced from each of the 15+ mother plants go into plugs, rooted then transplanted.

Apical cutting versus stem cutting

Apical cuttings originate from tissue culture material, i.e. the mother plant is maintained in a juvenile state throughout the production cycle. The high productivity potential is in the physiologically young tissue retained in a simple leaf stage which results in the high productivity per apical cutting in the field, 10-15+ tubers per cutting.

Stem cuttings generally implies that the mother plant has developed compound leaves, physiologically older. Normally mother plants for stem cuttings originate from a tuber, develop compound leaves, and sprouts and shoots are taken as cuttings. Stem cuttings originating from mother plants with fully developed compound leaves generally yield 2-3 tubers per stem (Fig. 4)



Figure 4. Production of stem cuttings, note mature mother plant (left) and stem cuttings taken from mature shoots (right)

Specific guidelines

Production of cuttings is divided into four phases:

- i. transplanting and acclimatization of tissue culture plantlets in the screenhouse
- ii. production of mother plants
- iii. production of rooted cuttings for transplanting in the field
- iv. hardening in the screenhouse

Transplanting tissue culture plantlets in the screenhouse

The initial tissue culture plant is planted in nursery beds or crates at a spacing of 5-15 x 5-15 cm. The spacing depends whether one will collect minitubers from the residual mother plants, and the size of the minitubers to be produced. In crates, fill the bottom of the crate with cocopeat, vermiculate, sterile sand or soil or mixture thereof, depending on what is available, deep enough to plant the tissue culture plantlets and subsequent cuttings that will serve as mother plants, or plant in individual plugs with same rooting media in a crate. If use plugs, they should be at least 50 mm diameter (Fig. 5.)



Figure 5. Transplanted tissue culture plants in nursery beds (left) and in plugs in crates (right).

After transplanting the tissue culture plantlets to the screenhouse, the plantlets are to remain under plastic cover until acclimatized to the screenhouse, about 5-10 days depending on conditions. Remove the plastic cover and ensure to provide proper nutrition as this a main constraint to productive production of cuttings.

Pinch the main shoot of the plantlet before making the first cutting to avoid apical dominance. Following multiple shoots develop from which cuttings for mother plants are produced (Fig. 6).



Figure 6a. Initial tissue culture plantlet ready to remove apical stem to avoid apical dominance (above).



6b. Following multiple shoots develop from which cuttings for mother plants and eventually transplant production are produced (below).

Production of cuttings: mother plants and rooted cuttings

As per figure 3a and 6b, mother plants will be produced from shoots produced by the initial tissue culture plantlet and subsequent cuttings until 3-4 weeks until the first lot of cuttings is to be transplanted in the field. At this point, new shoots are placed in plugs to produce rooted cuttings for transplanting.

Cut shoots once 3 nodes have developed and bury 2 nodes deep in the nursery beds or crates. Remember, roots develop from nodes, then stem and leaf growth follow, so want to promote root development first. Before working, disinfect hands and scissors with 70% ethanol. The best time to cut is in the morning and the mother plants should have been watered well the previous evening. Cut at 45° angle with a sharp and sterile scissors just below a node. Trim leaves to reduce transpiration and place cut stem in a labelled container filled with water, where they can remain up to 2 hours. The water prevents airlock in the xylem. Before planting, stems can be dipped in rooting hormone to enhance rooting (Fig. 7).



Figure 7. Shoots growing from mother plants showing where to cut a 3 node cutting (left). Trim lower leaves (center) and bury two nodes deep, roots will grow from the nodes. Place cut stems in water for up to 2 hours before putting into rooting medium (right).

The cut stems are subsequently planted in beds or plugs with growing media (cocopeat, vermiculate, sterile sand or soil or mixture thereof) that have been prepared in advance. Bury 2 nodes of the cut stem when planting, the third node remains above the ground (Fig. 8).



Figure 8. Planting cut stems to produce rooted cuttings (transplants for seed tuber production) into prepared trays

Plant Nutrition

After transplanting, the cuttings are immediately watered with nutrition solution. Don't apply too much nitrogen, it will delay the rooting. A balanced feeding regime will also avoid that the mother plants become overgrown. If plants require much irrigation alternate nutrient solution with water alone. Table 1 is a basic nutrient composition for cuttings. This can be optimized as per local conditions and experience.

Table 1. Nutrient composition to produce rooted cuttings of potato.

Soluble fertilizer	1000 liter tank (gm)	500 liter tank (gm)	200 liter tank (gm)
Potassium phosphate	136	68	27.2
Calcium nitrate	256	128	51.2
Potassium nitrate	504	252	101
Magnesium sulphate	100	50	20
Microsol B	12	6	2.4

Hardening rooted cuttings for transplanting

After cuttings are rooted, they need to be placed in an area of the screenhouse more exposed to ambient conditions, low shade net (20%), more vents, etc. to allow the cuttings to harden to be ready for transplanting (Fig. 9).



Figure 9. Section of screenhouse exposing the rooted cuttings to more light and wind to harden before commercial sale and transplanting.

Cuttings ready for transplanting, commercial sale

Cuttings can be transported in the trays they were produced in. In such cases a deposit or recovery system for the trays should be put into place.

Alternatively, the cuttings can be placed in flower boxes in 3-4 layers with a sheet of clean plastic between the layers. In such cases, the cuttings need to be panted within 24 hours of packing, or removed from packing and placed in protected location until planting (Fig. 10).



Figure 10. Rooted cuttings transported in 3-4 layers in a flower box.

Procedures to plant cuttings can be found [here](#).



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