OLIVECULTURE II
SCALE UP Scaling Up OliveCulture Value Chain and Promoting Climate Resilient Rural Development in Pakistan

ITALIAN AGENCY FOR DEVELOPMENT COOPERATION

CIHEAM BARI

OLIVE NURSERY PROPAGATION

TECHNICAL PROTOCOL SHEET

A simple, step-by-step guide for farmers and nursery managers

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PROPAGATION PERIOD

JAN	**FEB**	**MAR**	APR	MAY	JUN	JUL	AUG	**SEP**	**OCT**	NOV	DEC

SCOPE & PURPOSE

This technical sheet provides a complete, scientifically validated protocol for the propagation of olive (*Olea europaea* L.) planting material in certified nurseries in Pakistan.

GROWING MEDIA PREPARATION

Two distinct substrate formulations are required: one for the rooting bed (propagation phase) and one for the poly bag (growing phase). These parameters must not be conflated.

Rooting Bed Substrate

The rooting bed substrate must prioritize drainage, aeration, and disease-free conditions over nutrient content.

- **Recommended composition:** 60–70% coarse perlite + 30–40% vermiculite;
- **Alternative validated mix:** coarse washed river sand + perlite or peat moss;
- Pure peat, peat-sand, or sandy loam mixes yield only 5–28% rooting success;
- All substrates must be fully sterilized before use.

Poly Bag Growing Substrate

Once cuttings have rooted and are transferred to poly bags, a more nutritious, moisture-retentive substrate is appropriate:

- **Recommended composition:** 60–70% sandy loam soil (ensures proper drainage and aeration) + 30–40% well-decomposed peat moss or cocopeat or mature manure (improves moisture retention and cation exchange capacity);
- The mix must have adequate water-holding capacity to retain moisture and nutrients while minimizing leaching;
- Ensure the health of the media (soil, mixture, etc.) where the plants will be propagated and raised to avoid the occurrence of pests, such as nematodes and soil fungi;
- Sterilize all tools, containers, and growing media before reuse by disinfecting with a 10% sodium hypochlorite (NaOCl) solution followed by a clean water rinse.

SOIL SOLARIZATION

Soil solarization is a non-chemical disinfestation technique that utilizes solar radiation to control soil-borne pathogens, insects, and weeds. It is strongly recommended as a pre-planting treatment for both rooting beds and growing substrate stockpiles.

Procedure

- Thoroughly moisten the soil to field capacity before covering. Wet soil conducts heat more efficiently than dry soil, and moisture renders heat-weakened soil organisms more vulnerable to attack by beneficial soil microorganisms during and after treatment;
- Cover moist soil or substrate with a single or double layer of transparent (clear) polyethylene (PE) film, 25–50 microns thick. Clear PE film is essential; opaque or black film does not allow solar radiation penetration;
- Ensure film edges are buried or sealed to trap heat effectively. Aim to raise the upper soil layer temperatures to 40–55°C;
- Leave in place for a minimum of 4–6 weeks during the hottest period of the year (peak summer sunshine hours). In cooler, cloudier, or highland locations, extend to 6–8 weeks.

MOTHER PLANT QUALIFICATION & SOURCE MATERIAL

- Mother plants must have confirmed varietal identity through DNA analysis, supported by morphological characterization. According to NSDRA-approved guidelines and standards.

PROPAGATION MATERIAL

Cutting Selection and Preparation

- Cuttings must be taken from the middle portion of one-year-old, semi-hardwood shoots, flexible, partially lignified, and typically grey-brown in color;
- **Length:** 7-10 cm;
- **Diameter:** 0.4–0.7 cm;
- Each cutting must have 2–3 active axillary nodes.

Storage & Transport

- Store collected cuttings in a cold (2–8°C), high-humidity (>85% RH) environment during transport and before processing. Wrap in a damp cloth or plastic to prevent desiccation;
- It is preferable to process cuttings within 24–48 hours of collection. Avoid storage for more than 72 hours;
- Upon arrival at the nursery, prepare single-nodal or bi-nodal cuttings for rooting, ensuring a cut is made 4–6 mm below the basal node immediately prior to hormone treatment to expose fresh tissue.

ROOTING HORMONE APPLICATION

Application of auxin-based rooting hormones is essential to achieve commercially acceptable rooting rates in olive. Both IBA (Indole-3-butyric acid) and NAA (1-Naphthaleneacetic acid) are effective, with IBA generally preferred for its lower phytotoxicity at higher concentrations.

- Upon arrival at the nursery, after their preparation, immediately dip the cuttings in rooting hormone (IBA or NAA 3000-4000 ppm) for a few seconds, then transfer them to the sterilized mixture germination beds;
- Quick-dip method: dip just the bottom 1–2 cm of the cutting into the solution for 3–5 seconds;
- Shake off any excess. Do not soak the cutting for longer than 5 seconds;
- Insert the cutting into the moist rooting substrate immediately after dipping;
- Prepare fresh hormone solutions daily. Store stock solutions in dark, cool conditions.

PROPAGATION MANAGEMENT — ROOTING PHASE

Rooting Bench Design

- The rooting bench must be elevated 20–30 cm above ground level to prevent waterlogging and soil-borne pathogen ingress;
- The bench surface must be covered with a layer of coarse gravel and overlaid with a fine green netting to ensure free drainage while preventing contact between cutting bases and the ground;
- Enclose the entire rooting bench under a plastic tunnel of approximately 1 m height throughout the rooting phase to maintain a high-humidity microclimate around cuttings.

Maintain ideal environmental conditions throughout production:

Parameter	Target Range	Critical Threshold
Substrate temperature	20–24°C (68–75°F)	Below 18°C: rooting arrested; above 28°C: fungal rot risk
Ambient air temperature	20–27°C (68–81°F)	Above 30°C: heat stress; mist/shade required
Relative humidity	≈90% (rooting phase)	Below 70%: cutting desiccation; reduce after rooting
Light (PAR)	Low-moderate, avoid direct sun	Shade cloth (50–60%) recommended in summer
Substrate pH	5.5–6.5	Outside range inhibits auxin activity

Irrigation During Rooting

- During the first 7–10 days after insertion, maintain high humidity via intermittent misting (fine overhead spray) every 1–2 hours during daylight hours to prevent wilting;
- As rooting begins (typically 4–8 weeks), gradually reduce misting frequency to allow mild wilting stress, which stimulates root elongation;
- Avoid waterlogging of the substrate at all times. Excess moisture at the basal cut promotes Phytophthora and Pythium rot, the most common cause of propagation failure.

ACCLIMATIZATION & HARDENING

The transition from the high-humidity rooting tunnel to ambient nursery conditions is a physiologically critical stage. Abrupt exposure to low humidity and high light intensity following rooting causes severe transplant stress and high mortality.

- Once cuttings have produced a well-developed root system (typically 3-6 cm primary roots with visible secondary branching, achieved in 6–12 weeks depending on cultivar and season), begin gradual acclimatization;
- **Week 1–2:** Reduce relative humidity from 90% to 70–75% by gradually opening tunnel ends or reducing misting frequency;
- **Week 3–4:** Transfer rooted cuttings to a shaded green tunnel or shade house (50% shade cloth), maintaining 60–70% humidity. Water daily or every 2 days;
- **Week 5–8:** Progressively reduce shading to 30%, increase air movement, and reduce watering frequency to simulate nursery growing conditions;
- Only transfer plants to open or semi-open green tunnels after they have demonstrated active new shoot growth, a reliable indicator of successful root establishment;
- During hardening, handle plants carefully to avoid root disturbance. Root system damage during this phase is the second leading cause of nursery plant losses;
- During this phase, it may be necessary to carry out phytosanitary protection interventions using fungicides (e.g., copper-based products, which also contribute to tissue hardening) and, where required, insecticides targeting certain lepidopteran pests.

GROWING STAGE — POLY BAG MANAGEMENT

Containers

Bag feature	Requirement
Height	Minimum 20–25 cm
Diameter	10–15 cm
Color	Black (prevents algae from growing on the substrate)
Drainage holes	4–6 holes on sides and base, essential to prevent waterlogging

Irrigation

- Water freshly potted plants immediately after transplanting and daily for the first 5 days to assist root establishment.
- **During summer:** irrigate daily (or twice daily in extreme heat above 35°C).
- **During winter:** reduce to once every 2–3 days depending on substrate moisture.

Fertilization

- No fertilization should be applied during the rooting phase. Fertilization begins only after potting into poly bags and once new shoot growth is visible (2–4 weeks after potting).

Pest and Disease Management

- Nursery conditions of high humidity, dense planting, and young plant tissue create favorable environments for pest and disease outbreaks. A preventive integrated pest management (IPM) approach is mandatory.

FINAL PLANT STANDARDS & RELEASE CRITERIA

Plants are ready for dispatch to the field when they meet all of the following criteria.

Parameter	Minimum Standard
Plant height	50–75 cm from substrate surface to shoot tip
Stem form	Single, straight main stem; no forking below 50 cm
Root system	Well-developed, filling the poly bag; no circling roots; no root rot
Leaf condition	Minimum 12–16 healthy leaves; no significant lesions or chlorosis
Pest/disease status	Free from all regulated pests and notifiable diseases
Cultivar labelling	Variety name clearly tagged per plant or per batch

- Plants must be hardened off for a minimum of 4 weeks in open or semi-open conditions before dispatch to avoid transplant shock in field conditions.
- Irrigate plants thoroughly 12–24 hours before dispatch to ensure substrate is moist.
- Protect plants during transport from desiccation (wrap in shade cloth or breathable film) and from physical damage.
- Full traceability from mother plant to dispatched plant is required, and is essential for quality assurance and inspector verification.

QUICK REFERENCE — KEY NUMBERS

Keep this page handy in your nursery as a daily reference.

Parameter	Number to remember
Cutting length	07–10 cm
Cutting diameter	0.4–0.7 cm (pencil-width)
Nodes per cutting	2–3 nodes
Rooting hormone (IBA)	3,000–4,000 ppm, dip 3–5 seconds
Rooting bed substrate	60–70% perlite + 30–40% vermiculite or peat moss
Poly bag substrate	60–70% sandy loam + 30–40% compost/cocopeat or mature manure
Substrate temperature	20–24°C during rooting
Air temperature	20–27°C during rooting
Humidity (rooting phase)	~90%
Solarization duration	4–6 weeks (up to 8 weeks in cool areas)
Solarization temperature	40–55°C under the plastic
Time to rooting	6–12 weeks (varies by variety and season)
Acclimatization period	4–8 weeks before full exposure
Poly bag height	20–25 cm minimum
Poly bag diameter	10–15 cm
Drainage holes in the bag	4–6 holes
Final plant height	50–75 cm, single stem
Copper fungicide spray	Every 3–4 weeks in humid/rainy months

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