Summary of thesis

Introducing persimmons (*Diospyros kaki*) to Afghanistan is credited to returning migrants from neighboring countries, leading to successful cultivation in the eastern and northern regions. The recent establishment of commercial orchards has bolstered local production, although imports persist. *Diospyros lotus* is the common rootstock, and grafting remains the primary propagation method. Astringent persimmons dominate the orchards, necessitating artificial ripening. Ethylene is increasingly used for ripening, while some still employ calcium carbide or allow natural ripening on trees. Afghan farmers sell the fruits to contractors, who subsequently market and sell the fruit to consumers. Despite facing obstacles, there is significant potential for improving the persimmon industry in this country. The general objective of this study was to enhance persimmon vegetative propagation by streamlining labor-intensive steps, considering efficiency, and aligning with sustainable development goals.

Grafting, the sole method of persimmon propagation in Afghanistan, involves mud and polyethylene film covering, which is considered time-consuming and labor-intensive. Rootstocks were grafted onto persimmon cultivars to identify an efficient alternative using five treatments, including buddy tape, mud sealing, and others. The

buddy tape consistently demonstrated the highest graft success and outperformed other treatments, including the traditional mud approach.

The ‘MKR1’ persimmon rootstock, a patented variety in Japan, shows promise in dwarfing trees and enhancing yield efficiency. Traditional propagation with seedlings faces challenges, leading to genetic diversity and uneven sizes. Despite recent advances in cutting propagation, ideal conditions for ‘MKR1’ softwood cuttings remain unexplored. Softwood cutting also demands specialized equipment and substantial water volume, posing challenges in arid regions like remote Afghanistan. To address this, ‘MKR1’ cuttings immersed in 3000 mg L^{-1} IBA were planted in plastic pots with four substrates in late June, July, and August. Cuttings were irrigated using an intermittent mist or water-conserving TPT system developed in this study. Late June plantings showed the highest survival and rooting rates, with improved winter survival. The rooting medium minimally affected survival, with perlite having the lowest rooting percentage. While irrigation systems had no significant impact, the TPT proved an easily applicable and water-conserving alternative for resource-poor areas.

Plastic pollution poses a global threat, particularly in the nursery and greenhouse sectors, where 320 to 408 million pounds of plastic are used annually. Disposal of plastic waste is an environmental concern, especially in developing nations where recycling may not be practical. Compostable substrate-based pots, such as peat pots and peat pellets, promise to reduce plastic dependency for sustainable plant production. To assess the effectiveness of compostable pots in the rooting of ‘MKR1’ persimmon cuttings, considering the prior reliance on plastic pots, various factors were evaluated, including pot type, auxin application, and concentrations. Peat pots demonstrated survival and rooting rates similar to plastic pots, suggesting their feasibility as an eco-friendly alternative. The highest rooting percentage among peat pellets was cuttings quickly dipped in 2000 mg L^{-1} NAA. A comparable rooting rate to the quick-dip was observed when cuttings were planted in IBA 50 or 250 mg L^{-1} soaked pellets or when cuttings were sprayed with NAA 250 mg L^{-1}. These findings present compelling alternatives to the traditional auxin quick-dip method, offering efficiency and reducing the time and labor intensity associated with the process.

Efficient year-round ‘MKR1’ propagation faces challenges despite successful softwood cutting propagation. While micropropagation serves this purpose, the protocol requires optimization. Direct transplantation of ‘MKR1’ microshoots into commercial substrates was explored to eliminate jiffy pots and save resources. Shoots grown in MS or MS (1/2N) medium supplemented with 5µM zeatin were transplanted into either MetroMix®360 or half of MS (1/2N) hormone-free artificial medium after a quick dip in an IBA 1.25mM solution. The shoots of the artificial medium underwent a 10-day dark treatment. Subsequently, half of the shoots from each medium were transplanted into MetroMix®360, while the remaining half was left in the same medium at 28 °C under a 16-hour photoperiod. Regardless of the medium, shoots that underwent dark treatment exhibited significantly higher rooting percentages than those directly transplanted into MetroMix®360 without dark incubation. After the dark treatment, shoots from the MS medium achieved a one hundred percent rooting, whether transplanted into MetroMix®360 or left in the artificial medium. Despite successful rooting, the quick-dip IBA method remained labor-intensive. To address this, microshoots were exposed to a half MS (1/2N) rooting medium containing 1, 2, and 5 μM IBA solutions. Shoots quickly dipped in 1.25 mM IBA and planted in a hormone-free rooting medium served as a control. After a 10-day dark treatment, half of the shoots were transplanted into peat pellets, and the rest after 20 days. Optimal root and shoot growth were obtained with a 10-day transplantation and a medium containing 1 μM IBA, eliminating the need for the quick-dip method.

In conclusion, this comprehensive study explores sustainable alternatives, innovative techniques, and efficient protocols to enhance persimmon propagation, addressing challenges and fostering the growth of the persimmon industry.