

STUDY OF TRADITIONAL METHODS OF PLANTING FRUIT TREE SEEDLINGS AND
DESIGNING A PLANTING MACHINE

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ABSTRACT

This article presents the traditional methods of planting fruit tree seedlings on agricultural fields allocated for establishing fruit orchards, in accordance with agrotechnical standards. Since these traditional methods are highly labor-intensive, costly, and time-consuming, the paper proposes design considerations for developing a fully mechanized seedling planting machine. The envisioned machine would ensure high efficiency, reduced costs, and continuous planting of fruit tree seedlings in a short time, all while adhering to agro-technical requirements.

Keywords: Cultivated land, soil structure, orchard, fruit tree seedling, planting depth, planting width, machine, implement, rootstock, graft union, moisture, planting pit.

Introduction: Planting Periods, Land Preparation, and Selection of Fruit Species and Varieties

In Uzbekistan, fruit tree seedlings are mainly planted in two seasons: in autumn (November) and early spring (from early March to mid-April). In some cases, container-grown seedlings can also be planted until June.

Seedlings planted in late autumn tend to develop stronger root systems due to better soil adaptation, enabling faster growth in the following spring. However, in recent years, unusually cold winters with temperatures below -10°C have led to serious damage to roots and branches. Consequently, spring planting is considered more reliable. For physiological compatibility, planting in the first half of March is recommended, as delays reduce seedling viability.

Container-grown seedlings can be planted even up to June, as their root systems are minimally disturbed during transplanting [1].

For establishing new orchards, it is ideal to select fertile, high-bonitet soils. With proper agrotechnical practices, such orchards can yield high-quality produce. However, in practice, many new orchards are being established on less fertile, rocky, or hilly soils.

According to the National Variety Register of Uzbekistan, fruit species and varieties must be selected based on regional soil and climate conditions. The depth of the groundwater table should be at least:

- 1.5 m for dwarf rootstocks,
- 2.5 m for semi-dwarf rootstocks,
- 3.0 m for vigorous rootstocks.

Additionally, soil should be well-structured, moderately saline, and free from adverse environmental factors.

Land preparation includes plowing or deep loosening to 30–50 cm using subsoilers and plows. This should be performed in autumn with application of organic and mineral fertilizers. In February, land leveling is done using laser-guided graders to improve irrigation efficiency.

Selected fruit varieties must be high-yielding, disease- and pest-resistant, adaptable to local agro-climatic conditions, and suitable for export with favorable ripening, harvesting, and storage properties.

Main Section: Seedling Planting

To ensure maximum sunlight exposure and optimal photosynthesis, planting schemes vary by tree type and rootstock [2]:

- **Dwarf rootstocks:** 4x3 m, 4x2 m, 4x1.2 m
- **Semi-dwarf rootstocks:** 5x4 m, 5x3.5 m, 5x3 m
- **Vigorous rootstocks:** 5x4 m, 5x5 m, 6x4 m

The planting layout (Figure 1) is designed considering land relief, sun orientation, prevailing wind directions, irrigation system, and access roads.

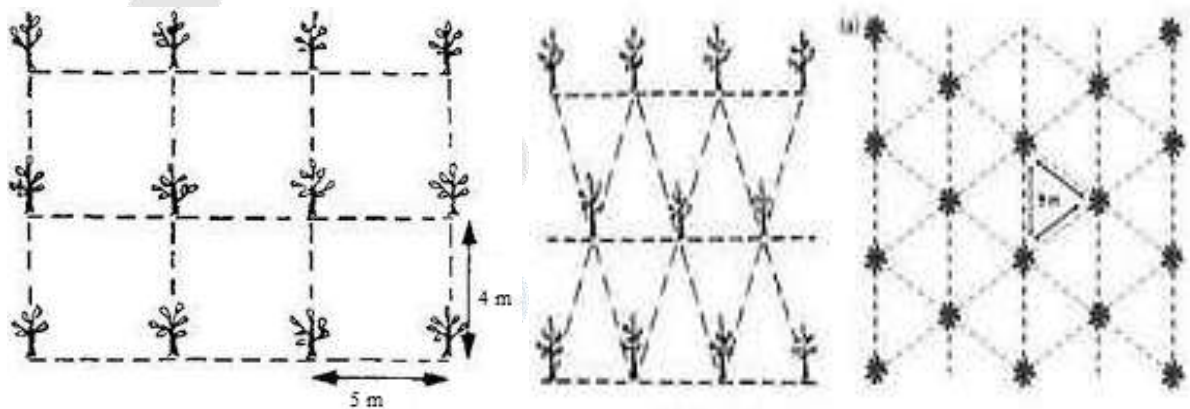


Figure 1: Layouts of Fruit Tree Planting Schemes

Planting should be conducted at ambient temperatures above +8°C and under favorable weather conditions (no precipitation or strong winds). The soil moisture content should range between 15% and 75%.

Based on soil structure and seedling root development, planting pits of 40x40 cm to 70x70 cm are prepared using two methods (Figure 2):

1. **Manual method:** Using hoes, spades, and other hand tools, the top 25 cm (cultivated layer) is removed separately from the subsoil.
2. **Semi-mechanized method:** Using tractor-mounted augers such as KYa-100, KNYu-100, KRK-60, and TM-Ea520b 2, which do not differentiate soil layers.

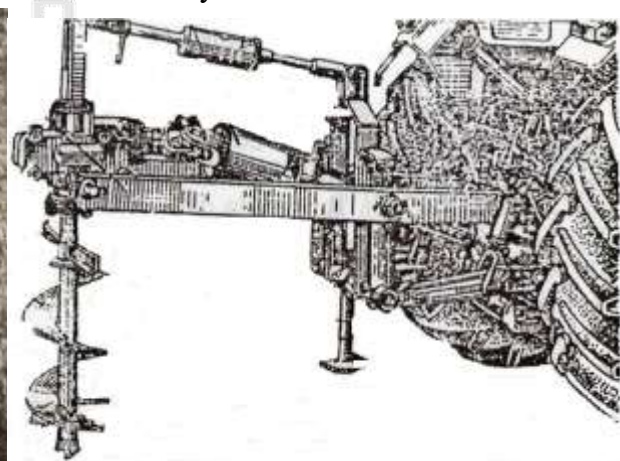


Figure 2: a) Manual pit preparation; b) KYa-100 mechanized auger for pit preparation

Planting is typically done with 2–3-year-old seedlings, which must meet agro-technical standards in terms of height, stem diameter, root system development, graft condition, branching, and dormant bud status.

Before planting, a 7–10 cm soft soil layer composed of a 3:1 mixture of decomposed manure and biohumus is placed at the pit bottom to enhance root development.

Damaged, excessively long, or thick roots are trimmed with sharp shears (Figure 3), stimulating the growth of feeder roots at the cut points, which promotes healthy establishment [3].



Figure 3 (continued): Pruning of seedling roots prior to planting

To protect against strong winds, the graft union should be oriented towards the north or in the direction of prevailing winds. Roots are dipped in a nutrient slurry made from a 1:1 mix of fertile soil and manure and soaked for at least one hour.

Seedlings are positioned vertically in the pit. When manually dug, the topsoil layer (first 25 cm) is used for initial covering, followed by the subsoil layer (next 20–25 cm) (Figure 4). In semi-mechanized methods, nutrient-rich soil is selected manually for root coverage.



Figure 4: a) Proper vertical placement of seedling; b) Step-by-step root covering procedure

To eliminate air pockets around the roots, seedlings are gently shaken 1–2 times during backfilling and then watered with 5–10 liters of water depending on soil moisture.

After watering, a 5–10 cm layer of fine topsoil is applied to prevent crusting, which could hinder root respiration and cause seedling decline.

To avoid damage from adverse conditions and prevent disease, the graft union should remain 5–10 cm above ground level (Figure 5).



Figure 5: a) Correct placement of graft union; b) Monitoring graft position

Proper planting, in compliance with agro-technical standards, enhances root establishment and ensures vigorous seedling growth (Figure 6).

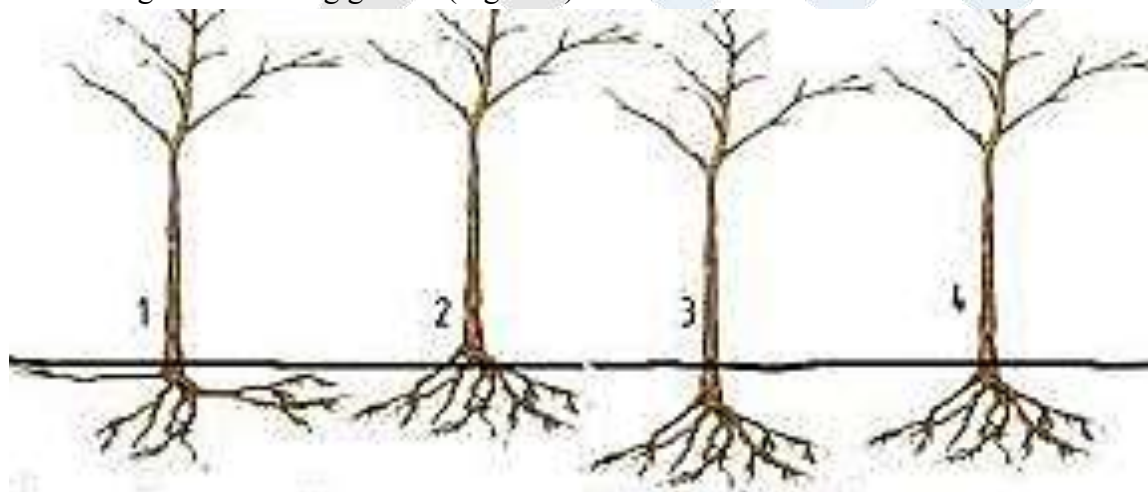


Figure 6: Evaluation of Planting Quality

1. Incorrect: Roots pointing upward
2. Incorrect: Roots exposed at surface
3. Incorrect: Graft union buried
4. Correct planting

Depending on the variety, 30–35% of the branches are pruned at 50–80 cm height post-planting. Special attention is given to root condition during transplanting, transportation, and storage.

Discussion

Despite ongoing use of traditional and semi-mechanized methods for establishing new orchards, these approaches remain labor-intensive and time-consuming. Delays in agro-technical operations can negatively affect orchard productivity. Consequently, mechanizing the seedling planting process has become a critical need.

Conclusion

To improve orchard establishment efficiency, reduce labor and costs, and meet agro-technical standards, a machine capable of continuous planting of fruit tree seedlings must be developed. This mechanization will:

- Optimize resource use
- Ensure timely and quality planting
- Improve labor productivity
- Minimize manual labor dependency

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Designing such machinery requires studying foreign-made planting machines and aggregates, analyzing their structural and operational principles, and identifying shortcomings. Based on this analysis and considering local soil and climatic conditions, a **new, locally adapted, efficient planting machine** should be developed.

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