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JUSTIFICATION OF THE SCHEME OF A MACHINE FOR FERTILIZER APPLICATION IN POMEGRANATE ROWS

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Abstract: The article substantiates the constructive scheme of a machine for deep loosening with the application of fertilizers, taking into account the agricultural technology of cultivating the pomegranate bush, and the methods of fertilizing.

Introduction: Pomegranate cultivation is one of the labor-intensive areas of horticulture. Several mechanized tasks exist, including shaping and maintaining pomegranate branches, removing pruned branches and shoots from row spaces, harvesting, irrigation, burying, and uncovering, which require manual labor. Pomegranates are planted in 4x2, 4x3, 5x3 m schemes and enter fruiting in 3-4 years. Its sensitivity to winter frost is a disadvantage, so it is often buried in winter in most regions.

The vegetative period of pomegranate starts in the second half of March and the beginning of April. As soon as the pomegranate seedling is planted, roots start to develop

and grow downward from the buried part. Thin and straight horizontal roots start to appear. Depending on the age of the pomegranate bush, the roots develop intensively in vertical and horizontal directions, leading to the formation of a taproot. For fruit-bearing pomegranate bushes, taproots develop both vertically and horizontally.

Machines for burying and uncovering pomegranates are designed with a curved movement direction. However, the pomegranate bush architecture has not been studied for designing cultivators and devices for processing row spaces and around the bush.

One of the main factors for increasing the productivity of pomegranate orchards is the simultaneous cutting of roots and the application of mineral fertilizers at a depth of 30-35 cm during soil loosening. Studies conducted in Turkey, Azerbaijan, and Uzbekistan emphasize that this approach increases productivity by 22.25% compared to existing technology.

Based on the above, the machine must:

- Apply fertilizer in a wide strip and perform deep loosening and irrigation at a distance of 50-60 cm from the row axis.
- The loosening tools (working organs) should loosen the soil to a depth of 35-40 cm while applying fertilizer to a depth of 20 cm and a width of 40 cm.
- The fertilizer distribution device should ensure the application of powdered and granular mineral fertilizers at a rate of 150-350 kg/ha using a hydraulic motor.
- The working speed of the deep loosening-fertilizing machine should not exceed 4.5 km/h.

A new design of the machine for deep loosening, cutting roots, and applying fertilizer in the row spaces of pomegranate has been developed, and an industrial prototype has been made (Fig. 1). It consists of a lifting frame (1), support wheels (2), a trailer (3), a bunker (4), a hydraulic motor (5), a fertilizer distributor (6), and a deep loosener (7). The dimensions and processing technology of the machine's working part are crucial.

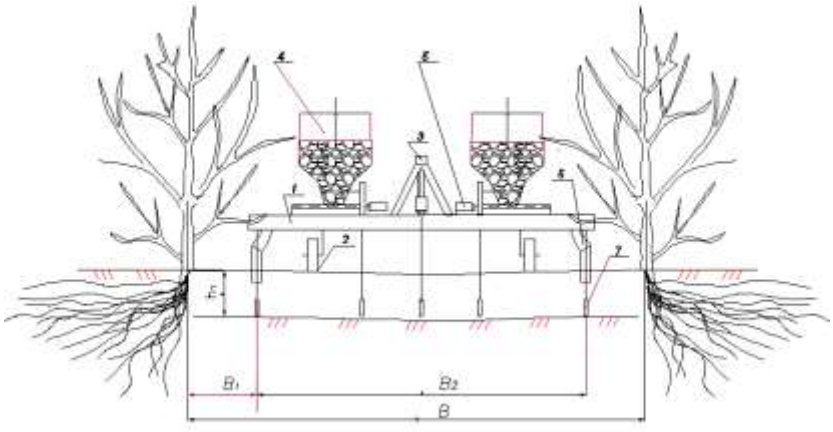

Fig. 1: Scheme of the machine for deep loosening, cutting roots, and applying fertilizer in pomegranate row spaces.

1 – Lifting frame, 2 – Support wheel, 3 – Trailer, 4 – Bunker, 5 – Hydraulic motor, 6 – Fertilizer distributor, 7 – Deep loosener.

Fig. 2: Machine for deep loosening, cutting roots, and applying fertilizer in pomegranate row spaces.

Research results show that regeneration processes are intense in roots cut 50 cm from the trunk. Additionally, the length of new roots at 125 cm from the trunk increases by 48.5% to 50.8% compared to cut roots, and a root cluster forms. Based on these findings, the design of the root-cutting and deep fertilizing tool has been developed.

According to agro-technical requirements, the fertilizer applied to the top layer should be in a wide strip. Therefore, the rear part of the side fertilizer distributor is reduced relative to the front part to ensure the distribution of fertilizer over various distances, forming a strip. The reduction angle was varied from 30° to 60° in 10° intervals, and experiments were conducted.

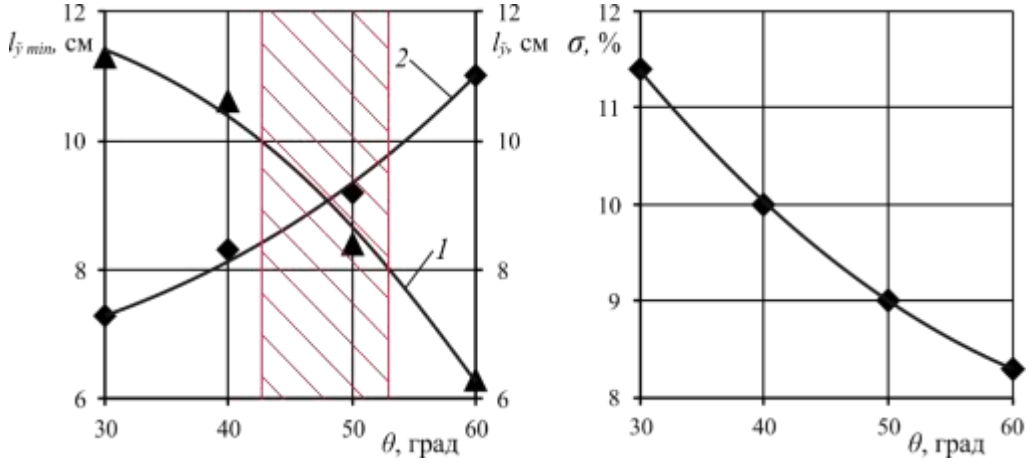

Fig. 3: Change in the performance of the fertilizer distributor depending on the reduction angle of the side fertilizer distributor.
a) Fertilizer drop distance (1) and strip width (2); b) Fertilizer distribution unevenness.

Fig. 3 shows that when the reduction angle of the side fertilizer distributor is changed from 30° to 60°, the drop distance of the fertilizer decreases from 11.4 cm to 6.3 cm, and the strip width increases from 7.3 cm to 11.0 cm. This is because increasing the reduction angle shortens the length of the rear part of the side distributor, enlarging the surface area where the fertilizer falls. Consequently, the width of the fertilizer strip

increases. The distribution unevenness of the strip decreases with the increase in the reduction angle.

In accordance with agro-technical requirements, the fertilizer drop distance and the opening angle of the distributor should be between 35°, ensuring an unevenness of 8.8-9.55% in the fertilizer strip width.

Conclusion: One of the main factors in increasing the productivity of pomegranate orchards is the simultaneous cutting of roots and application of mineral fertilizers to a depth of 30-35 cm during soil loosening, which can increase productivity by up to 30% compared to existing technology.

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