



TEST RESULTS AND TECHNICO-ECONOMIC INDICATORS OF A GRAPEFRUIT TREE-PLANTING MACHINE

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Abstract

The article analyses the prototype of a pomegranate stem-cutter, its field trial results and its technical and economic indicators. The research established the machine's structural and technological advantages, its working efficiency, energy consumption, fuel economy, and economic efficiency. The trials conducted confirmed the machine's practical effectiveness, and it was recommended for production.

Keywords: Pomegranate suckering machine, stacker-layer, field trial, technical specification, economic efficiency, energy consumption, work performance.

Introduction

The mechanisation of pomegranate orchard care and winterisation is of pressing importance in the agriculture of the Republic of Uzbekistan. At present, the task of burying grapevine trunks for the winter is often carried out by manual labour, which reduces labour productivity, increases energy consumption and has a negative impact on the cost of the product. Therefore, the development of a machine for burying pomegranate saplings, the improvement of its structural design, and the determination of its technical and economic indicators is a pressing scientific and practical task at present [1; 2; 3; 4; 5; 6; 7; 8; 9; 10].

Based on theoretical and experimental research [11], a prototype of a pomegranate stump puller has been developed [12]. The machine was developed by 'BMKB – Agromash' JSC [13], and is compatible with 4th–5th class tractors



such as the NEW HOLLAND T7060 [14]. Experiments were conducted in the Mirzaobod district of the Sirdaryo region [15]. It can be towed by 4th-5th class tractors, such as the NEW HOLLAND T7060 (fig.1).



Fig. 1. A machine that buried pomegranate bushes

The trials were conducted at the ‘Zulfiya Umarova’ and ‘Usmonobod Anorzori’ farms in the Mirzaobod district of Sirdaryo province and the Boyovut district, respectively. The trials were conducted in the autumn of 2023–2024, during the period of burying pomegranate stumps [16].

The machine consists of a harvester, a pusher, soil-turning bodies, a frame, support wheels, and scrapers [17]. During operation, the harrow collects the pomegranate branches, the pusher presses them onto the ground surface, and the soil-covering bodies cover them, ensuring they are completely buried (Table 1). Field trials conducted demonstrated that all of the machine's technical and technological parameters meet the specified requirements [18]. The trials were carried out at speeds of 5 and 7 km/h. The working depth was 36 cm (Table 2).



Table 1 Results of field trials of a machine equipped with a harrowing-and-laying implement for planting pomegranate seedlings

№	Names of the indicators	The value of the indicators		
		Initial requirements	ATKM-1 (conditional)	
			5 km/h	7 km/h
1.	Speed of the aggregate, km/h	5-7	5,1	6,8
2.	Degree of cut and crush of the pomegranate stem, %	≤ 3	1,8	2,9
3.	Degree of stem breakage, %	≤ 1,5	0,7	1,3
4.	Degree of stem detachment, %	≤ 1	0,3	0,6
5.	Damage rate of pomegranate branches, %	≤ 5	3,8	4,6
6.	Work productivity, ha/h - during the main working period - during the operational period	2,0-3,2 1,4-2,2	2,0 1,2	2,8 1,4
7.	Fuel consumption, kg/h	≤ 22,5	16,8	18,7

Table 2 Technical specifications of the machine equipped with a harrowing-and-planting unit for planting developed pomegranate seedlings

No	Indicator name	Unit of measurement	Indicator value
1.	Type	-	swinging
2.	Tractor class (make) for combination operation	-	4-5 (CASE PUMA 180, Magnum 8940, MX-255, NEW HOLLAND T7060, ARION-630)
3.	Working speed	km/h	5,0-7,0
4.	Main time productivity	ha/h	2,0-2,8
5.	Fuel consumption, maximum	kg/ha	22,5
6.	Power required, minimum	kVt	120
7.	Transport clearance of the machine, minimum	mm	300
8.	Servicing personnel (tractor driver)	soldier	1
9.	Annual regional workload	h	175,5
10.	Weight: of the implement of the harrow-seeder	kg	600
11.	Dimensions: - Length - Width - Height	mm	7420 2200 1200



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The results showed that the machine's working quality and energy efficiency fully comply with agrotechnical requirements. The damage rate to pomegranate stems was minimal, ranging from 1.8–3.8% at a speed of 5 km/h [19].

Furthermore, compared with the existing MUG-1 machine [20], the new machine's work efficiency was 2.2 times higher, while its fuel consumption was 20.9% lower [21].

Calculations GOST R 53056-2008 'Methods of economic evaluation' [22], RD Uz 63.03-98 "Testing of agricultural machinery. Methods for calculating the economic efficiency of agricultural machinery under test" [23] GOST R 53056-2008 'Methods of economic evaluation', RD Uz 63.03-98 'Testing of agricultural machinery. Methods for calculating the economic efficiency of agricultural machinery under test' [24; 25].

When using the new machine, the labour required to cultivate 1 hectare is reduced by 95.68%, and operating costs are reduced by 20.9%.

According to the calculation results, the annual economic effect was determined as follows:

$$E_y = (I_{MVT-1+qk} - I_{ATKM-1}) \cdot W_x = (598340.64 - 473044.7) \cdot 175.5 = 21989433.8 \text{ UZS}$$

Figure 1 shows the machine's tractor-mounted condition without the front wheels, while Figure 2 shows its appearance during operation.

Conclusion

The tests conducted demonstrated that the machine's technical and technological characteristics meet the specified requirements. With the help of a new adapter-cutter, the machine's productivity increased by 2.2 times. Compared to existing technology, labour costs are reduced by 95.68% and operating costs by 20.9%. The machine fully automates the process of harvesting apricots and ensures economic efficiency.



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