Analysis of technical and operational indicators of machines for planting seedlings

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Abstract. The purpose of the analysis of machines for planting seedlings produced by various manufacturers was to determine the best ratio of balance prices and labor costs for machine planting of seedlings. It was established that the highest competitiveness coefficient was obtained for a 4-row planting machine with a carousel planting apparatus.

In Russia, vegetables are grown in seedlings on about half of the open ground allotted for them. For this purpose, about 15 billion pieces of seedlings are produced annually in protected soil structures [1].

Vegetable crops produced by seedling technology include tomatoes, cabbage, and peppers. In addition, strawberries, tobacco and flowers are planted with seedlings [2]. The area of their planting in Russia is on average about 100-150 thousand hectares, including tomatoes – 10-50 thousand hectares [3].

Seedlings are planted mechanically using transplanting machines [4, 5]. They are produced in various countries: Italy, Poland, Belarus [6, 7, 8]. Serial production is being applied in the Russian Federation.

In 2008, GOST R 53057-2008 'Agricultural machines. COMPETITIVENESS ASSESS-MENT METHODS' [9] came into effect, according to which the integral indicator of competitiveness for an agricultural machine from 1.3 and above indicates a high level of competitiveness.

The purpose of the analysis of functional diagrams and designs of seedling planting machines produced by various manufacturers was to determine the most optimal ratio of balance prices and labor costs for machine planting of seedlings.

Monitoring of functional diagrams and designs of machines for planting seedlings by various manufacturers (Fig. 1-5) made it possible to form a summary table of their technical and operational characteristics (Table 1).

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Fig. 1. PATRYK-2. Carousel planting machine



Fig. 2. F-18. Semi-automatic planting machine



Fig. 3. California Semi-automatic planting machine



Fig. 4. Sfoggia .Planting machine



Fig. 5. Itala. Planting machine

It has been established that now the most widespread are planting devices in the form of a carousel disc [6, 7, 8].

Names of	Machine brand							
characteristics	Series	Patryk-2	F-18	California	Sfoggia	Itala		
	SKR							
	Termoplin							
	(Serbia)							
Number of	2/2	4/4	2/1	4/4	2/1	4/4		
rows/people								
Drigg thousand	620	1.04	740	202	540	720.000		
rubles	030	1,04	740	383	540	720 000		
Planting apparatus	carousel	carousel	carousel	carousel	carousel	Chain		
	disc (10	disc (6	disc (18	disc (6	disc (10	for 10		
	cups)	cups)	cups)	cups)	pots)	grips		
Planting device	5000-	3 600	7000	4 000	6500 -	1500 -		
productivity,	6000				7000	2000		
plants/hour								

Table 1. Performance characteristics of planting machines

An integral indicator was taken as a criterion for assessing competitiveness, taking into account the following factors: balance prices of machines for planting seedlings and labor costs for machine planting [9].

The integral indicator of the competitiveness of the machine, k_M , was calculated using the equation [9]:

$$k_M = k_1 \gamma_1 + k_3 \gamma_3 \tag{1}$$

The factor coefficient k_1 of the planting machine's price was calculated according to the formula [9]:

$$k_1 = \frac{\overline{B}_6}{\overline{B}_\kappa} \tag{2}$$

The factor coefficient k_3 of labor costs for machine planting of seedlings was calculated by the formula [9]:

$$k_3 = \frac{3_{\kappa}}{3_6} \tag{3}$$

The results of calculations to determine integral indicators of the competitiveness of machines for planting seedlings are presented in Table 2.

Firm, brand (model)	ce cost, usand bles	abor osts, le h/ha	Factor coefficients		Integral indi- cator of com- petitiveness κ _i
	Balan tho ru	L. cc peop	Prices k1	Labour costs K3	
Sfossia (competing machine)	540	5	1.3	1.9	1.6
Itala (basic machine)	720	2.6	1.0	1.0	1.0
California (competing machine) (Italy)	383.8	5	1.9	1.9	1.9
F -18 (competing machine)	740	2.9	0.9	1.1	1.04
Patryk-2 (competing machine)	1039	5.5	0.7	2.1	1.4
Termoplin (competing machine)	630	3.3	1.14	1.3	1.2

Analysis of the calculation results of integral indicators of competitiveness for planting machines of domestic and foreign manufacturers, presented in Table 2, shows that the highest competitiveness coefficient κ_i was obtained from *California* planting machine due to a more optimal ratio of balance prices and labor costs in comparison with other machines.

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