Analysis of technical and operational indicators of machines for planting seedlings

Yevgeniy I. Vinevskiy* and *Vladislav S. Lopatin*

Kuban State Agrarian University named after I.T. Trubilin, Krasnodar, Russia

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 ASSESSMENT 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).

* Corresponding author: vinevski@mail.ru

© The Authors, published by EDP Sciences. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (http://creativecommons.org/licenses/by/4.0/).

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].

Table 1. Performance characteristics of planting machines

Names of characteristics	Machine brand					
	Series SKR Termoplin (Serbia)	Patryk-2	F-18	California	Sfoggia	Itala
Number of rows/people	2/2	4/4	2/1	4/4	2/1	4/4
Price, thousand rubles	630	1,04	740	383	540	720 000
Planting apparatus	carousel disc (10 cups)	carousel disc (6 cups)	carousel disc (18 cups)	carousel disc (6 cups)	carousel disc (10 pots)	Chain for 10 grips
Planting device productivity, plants/hour	5000-6000	3 600	7000	4 000	6500 - 7000	1500 - 2000

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]:

$$k_M = k_1\gamma_1 + k_3\gamma_3 \quad (1)$$

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

$$k_1 = \frac{Б_б}{Б_к} \quad (2)$$

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

$$k_3 = \frac{З_к}{З_б} \quad (3)$$

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

Table 2. Integral indicators of competitiveness for planting machines.

Firm, brand (model)	Balance cost, thousand rubles	Labor costs, people h/ha	Factor coefficients		Integral indicator of competitiveness κ_i
			Prices k_1	Labour costs κ_3	
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.

References

1. http://www.spec-kniga.ru/rastenievodstvo/ovoshchevodstvo-otkrytogo-grunta/obshchie-voprosy-promyshlennogo-proizvodstva-ovoshchej-proizvodstvo-rassady-i-vysadka-ee-v-otkrytyj-grunt.html.

2. http://www.vniitti.ru/.
3. https://ab-centre.ru/news/posevnye-ploschadi-ovoschey-otkrytogo-grunta-v-rossii-itogi-2019-goda.
4. Vinevskiy E.I. Machine technologies and complexes of technical means for tobacco production (Mechanical and technological justification). Monograph. - Krasnodar: Education-South Publ., 2017. - 173p., with ill. ISBN 978-5-93491-750-1
5. Tobacco and tobacco products. Volume 1. Tobacco. Agrotechnology of tobacco production. Edited by V.A. Salomatin. Krasnodar: Education – South Publ., 2018. – 229 p. ISBN 978-5-93491-791-4.
6. https://www.agrobase.ru/catalog/machinery/machinery_81f7df10-6984-4fa0-b437-5553e23d8d60.
7. http://polymya-agro.by/.
8. http://www.ferraricostruzioni.com/ru/index.
9. GOST R 53057-2008 'Agricultural machines. COMPETITIVENESS ASSESSMENT METHODS'. Moscow, Standartinform Publ., 2009.