DETERMINING THE OPTIMAL WORKING MODES OF WORKING COMBINED MACHINES IN TEA PLANTATIONS USING THE THEORY OF SIMILARITY AND DIMENSION

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Abstract: *The article describes the combined aggregate that we use in the tea-growing sector, developed on the base* ***T-16 МГЧ****, on the basis of the obtained patent* ***GE P 2016 6491 B****. The theory of similarity and dimension has been used, functional connection between the optimization parameters and the acting factors is determined and the regressive equation which is the basis the optimal working modes are selected.*
Keywords: *TEA, TRACTOR, COMBINED MACHINE, MOTTLED-SHIVERING, AGGREGATE.*

1. Introduction:

As you know, the first tea-picking machine was manufactured in Georgia and the serial production started in ***1963*** - tea-picking machine ***Georgia***

Tea is one of the main cultures in Georgia. Currently, due to known reasons, the tea plantations are afforested or diminished and therefore it is necessary to rehabilitate such plantations. The main goal of the ***2015-2020*** strategic plan of agricultural development of Georgia is to restore tea-growing, which is confirmed by the Government of Georgia Decree ***№20*** of ***18*** January ***2016*** and the state program "***Georgian Tea***" regarding rehabilitation of tea plantations.

2. Main part

In ***2017-2018***, with the purpose of solving the above problems, the Agro Engineering Research Division of the Scientific-Research Center of Agriculture worked on the theme of the project "Development of the technical means of tea-cultivation". During these years we have developed and implemented the following technical means:

1. Input device of mineral fertilizer;
2. Pruning-grinding device for the surface of tea-bushes;
3. Cultivator of processing of the soil in row spacing.

The employees of the Agro Engineering division of the Scientific-Research Center of Agriculture worked out the new principal scheme of combined machine on the bases of the tractor ***T- 16 МГЧ***, on which the patent was issued ***GE P 2016 6491 B***. [4, 5] According to this scheme, experimental design has been prepared (**fig-1, fig-2**), on which the technical means aggregation was implemented on the self-propelled ***T-16 МГЧ***. The laboratory and field examinations were conducted. The above-mentioned machine was presented in the village of Tsilkani at the Agricultural Industry Exhibition - **25.12.2018**. http://srca.gov.ge/news/17365. The machine was positively assessed: by the Academy of Agricultural Sciences, by the Institute of Machine Mechanics and by the high-ranking specialists of the relevant specialty of Ltd. „Mechanizator''.

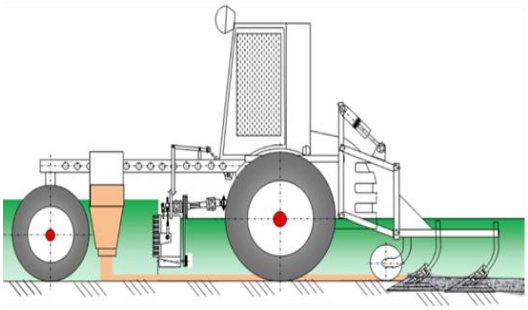

Fig-1, *Sketch drawing (combined machine)*

Fig-2, *Experimental sample (combined machine)*

Results of theoretical research

Theoretical studies have been carried out, using the theory of similarity and dimension. Present them.

Table.1: *The list of factors affecting the power of the tractor*

№	The name of the optimization parameter and factors	designation	The dimension in the system Si	Dimension, expressions by the symbols of quantities
1	power	N	watt	L^2MT^{-3}
2	the speed of movement of the tractor	$\boldsymbol{V}$	m/s	LT^{-1}
3	undercut resistance	$\boldsymbol{P}$	newton	LMT^{-2}
4	stem density	$\boldsymbol{\rho}$	kg/m^3	ML^{-3}
5	radius of trimming machine	R	m	L
6	cutting height	h	m	L
7	cutting width	b	m	L

Functional connection between optimization parameter and the factors affecting on it have the following face:

$$N = f(V, \rho, P, R, h, b)$$

This dependence can be expressed as similarity criteria. Their number is determined by π - theorem of dimensional analysis [1].

$$r = N - n$$

$\boldsymbol{N}-$ number of values, $\boldsymbol{n}-$ number of main factors. These factors should be selected as follows, to determine the exponents of their dimensions differed from zero. subject to these requirements, as the main factors we accept - the speed of movement of the tractor – $\boldsymbol{V}$, undercut resistance – $\boldsymbol{P}$ and stem density – $\boldsymbol{\rho}$.

The dimensions of these quantities can be represented as follows:

$$[V] = LM^0T^{-1}$$
$$[P] = LMT^{-2}$$
$$[\rho] = L^{-3}MT^0$$

The determinant of the exponents of these quantities is equal to:

$$\Delta = \begin{vmatrix} 1 & 0 & -1 \\ 1 & 1 & -2 \\ -3 & 1 & 0 \end{vmatrix} = -2 \quad \neq 0$$

This means that the main factors are chosen correctly.

number of similarity criteria:

$$r = N - n = 7 - 3 = 4$$

It is necessary to obtain characteristic similarity criteria:

$$\pi = N\, V^{\alpha}\, \rho^{\beta}\, P^{\gamma} = 1$$
$$\pi_1 = R\, V^{\alpha_1}\, \rho^{\beta_1}\, P^{\gamma_1} = 1$$
$$\pi_2 = h\, V^{\alpha_2}\, \rho^{\beta_2}\, P^{\gamma_2} = 1$$
$$\pi_3 = b\, V^{\alpha_3}\, \rho^{\beta_3}\, P^{\gamma_3} = 1$$

Where $\alpha_i,\ \beta_i,\ \gamma_i -$ Unknown features.

To π_i - similarity criteria have become dimensionless, the exponents should be as follows, to replace each variable with the appropriate combination M, L, T in the resulting expressions, the exponent of the basic dimension was equal to zero [2]

With this in mind, it is possible to obtain a defined similarity criterion:

$$N\, V^{\alpha}\, \rho^{\beta}\, P^{\gamma} = L^2MT^{-3}\, L^{\alpha}T^{-\alpha}\, L^{-3\beta}M^{\beta}\, L^{\gamma}M^{\gamma}T^{-2\gamma} = L^0M^0T^0 = 1$$

We obtain the following linear equations:

$$2 + \alpha - 3\beta + \gamma = 0$$
$$1 + \beta + \gamma = 0$$
$$-3 - \alpha - 2\gamma = 0$$

The solution of these equations gives:

$$\alpha = -1;\ \beta = -2;\ \gamma = -1$$

Accordingly, the defined criterion has the form:

$$\pi = \frac{N}{PV}$$

analogically, we obtain the defining similarity criteria:

$$\pi_1 = RV\sqrt{\frac{P}{\rho}};\quad \pi_2 = hV\sqrt{\frac{P}{\rho}};\quad \pi_3 = bV\sqrt{\frac{P}{\rho}}.$$

physical meaning of the obtained criteria following:

$$\frac{N}{PV}$$

quality criterion dimensionless engine power. the rest are technological criteria, similarity:

$RV\sqrt{\frac{P}{\rho}}$ - defining criterion. radius of trimming machine;

$hV\sqrt{\frac{P}{\rho}}$ - defining criterion. cutting height;

$bV\sqrt{\frac{P}{\rho}}$ - defining criterion. cutting width.

Primary reporting features are accepted. The main research will continue within the grant.

3. Conclusions:

1. the problems of mechanization in tea growing in Georgia are analyzed;
2. methods for solving the problem are given;
3. we have offered a new combined machine for work in tea plantations;
4. theoretical research conducted.

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