STUDYING THE INFLUENCE OF MODES AND OPERATING CONDITIONS ON THE ENERGY INDICATORS OF MTA

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Abstract. *Depending on the modes and operating conditions, the dependence of the magnitude of the traction resistance of the MTA for the application of mineral fertilizers has been established. At the same time, based on experimental studies, a mathematical model was obtained that determines their optimal values.*

Keywords: *energy indicators, spreader, fertilizers, traction resistance, modes, function, mass, speed, application dose, hardness, humidity, mathematical planning, loading, factor, matrix, experiment, regression coefficient, quality.*

INTRODUCTION

Determining the degree of influence of the speed of movement of the fertilizer mass, application dose, soil hardness and moisture on the value of traction resistance and substantiating their optimal value are of certain practical importance both for assessing the energy indicator of the fertilizer spreader and for the quality of its work.

We conducted research with a prototype of the KSH-4 mineral fertilizer spreader. The research was carried out using the method of mathematical experimental planning [1].

The dependence of the traction resistance of fertilizer spreaders on the values of factors that determine the operating modes and conditions of the machine can be represented as a function:

$$R_a = f(m, V, D, H, W), \qquad (1)$$

where

m - weight of fertilizers in the spreader body, kg;

V - unit movement speed, m/s;

D - fertilizer dose, kg/ha;

H, W - soil hardness and moisture, respectively, МПа,%.

The experiments were carried out on a horizontal section of the field with maximum loading of the spreader body with fertilizer (ammophos) on different backgrounds: after harvesting cotton stalks, under alfalfa and after major leveling. In accordance with agrotechnical requirements, the most typical values of the speed of movement of the unit and the dose of fertilizer were chosen.

According to the study plan, the values of the influencing factors varied within certain limits (Table I).

In order to reduce the influence of external non-controlling factors on the magnitude of the response function, the sequence of experiments was determined by randomization using tables of random numbers [1].

Table 1

Values of influencing factors by levels of variation

Factor	Conditional designation factors	Variation interval	Factor level:		
			Lower	basic (0)	upper [(+ 1)
Movement speed m/s	X1	1,2	1,7	2,9	4,1
Application dose, kg/ha	X2	200	350	550	750
Soil hardness, MPa	X3	0,5	2,0	2,5	3,0

Table 2

Planning matrix and experimental results

Factor			Traction resistance of the unit, kN			
X1	X2	x3	Ra1	Ra2	Ra3	Ra cp
-1	-1	+1	2,97	2,72	2,77	2,82
+1	-1	-1	3,42	3,66	3,39	3,49
-1	+1	-1	3,145	3,145	3,37	3,22
+1	+ 1	+1	3,56	3,24	3..28	3,36
-1	0	0	2,98	2,94	3,14	3,02
+1	0	0	3,29	3,50	3,26	3,35
0	-1	0	3,03	3,19	3,05	3,09
0	+1	0	3,51	3,29	3,28	3,36
0	0	-1	3,23	3,23	3,47	3,31
0	0	+1	2,98	3,17	3,00	3,05
0	0	0	3,32	3,10	3,12	3,18

As a result of processing the experimental data, we obtained a mathematical model of the dependence of the traction resistance of the mineral fertilizer spreader on the considered factors that determine the operating modes and conditions:

$$Y = 3.188 + 0.19X_1 - 0.13X_3 \quad (2)$$

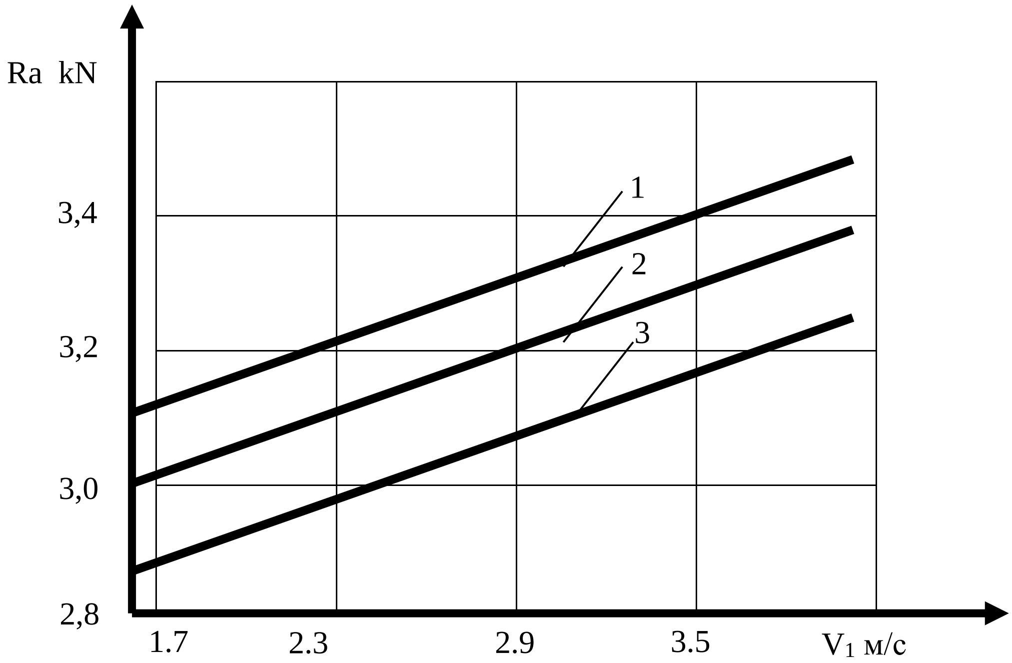

Fig. 1. Dependence of the traction resistance of the unit Ra on the speed of movement V for different values of soil hardness H: 1 -H = 2 MPa, 2-H = 2.5 MPa, 3 -H = 3.0 MPa.

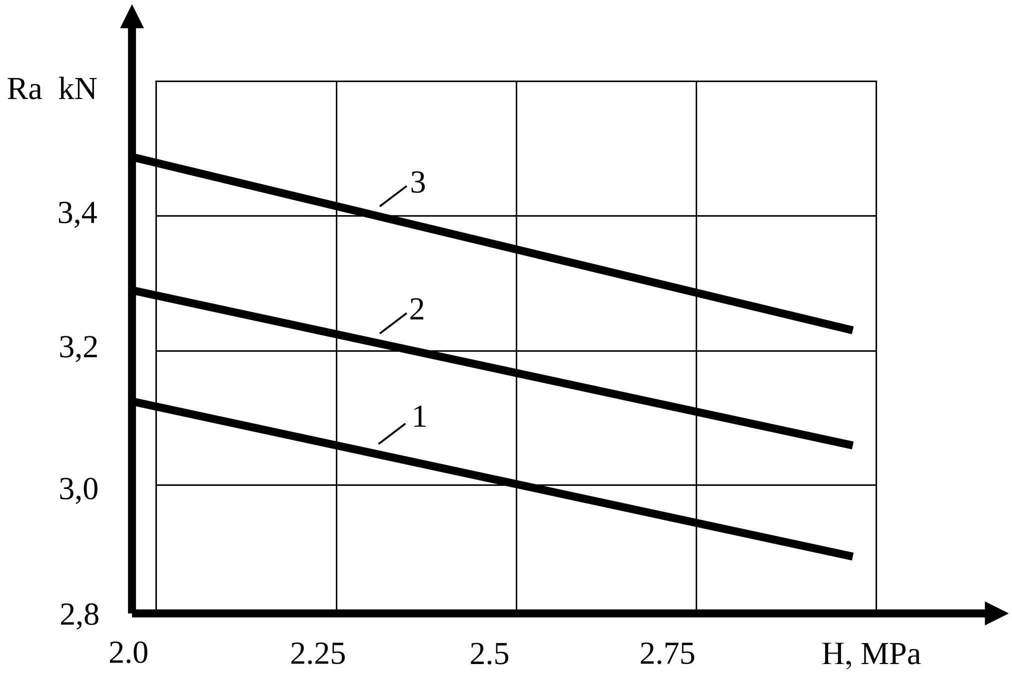

Fig. 2. Dependence of the traction resistance of the unit R_a on soil hardness H at different values of movement speed V:
1 -V= 1,7 м/с, 2 -V =2,9 м/с, 3 - V = 4,1 м/с.

Analysis of the values of the model coefficients allows us to assess the significance of the contribution of each factor to the value of the response function. Factor X_1 (V) has the greatest significance compared to factor X_3 (H), and factor X_2, i.e. the application dose (D) does not affect the traction resistance of the unit.

Based on the obtained model (2), graphs were constructed of the dependence of the traction resistance of the KSH-4 mineral fertilizer spreader on the factors that determine the modes (Fig. I) and conditions (Fig. 2) of its operation.

The dependencies R_a=f_1 (V) and R_a=f_2 (H) are linear. With a decrease in soil hardness within 3...2 MPa and with an increase in movement speed - 1.7...4.1 m/s, the traction resistance of the unit increases within 2.86...3.5 kN.

CONCLUSIONS

1. Mathematical model (2) allows you to obtain information about the traction resistance of the mineral fertilizer spreader when the MTA operates in any given modes and operating conditions.

2. While maintaining agrotechnical indicators for the quality of application, it is possible to increase the speed mode of MTA operation under all given operating conditions.

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