EXPERIMENTAL RESEARCH ON THE WORKING PROCESS OF VERTICAL ROTOR PEDES

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ABSTRACT

The article presents results obtained in the experimental research of the working process of vertical rotor harrows. The elementary results regarding the qualitative indices of the work process are presented: the degree of soil crushing, the degree of soil leveling, as well as some process performance factors: tensile strength, fuel consumption and fuel consumption specific to the unit. productivity. For each of the quality indices of the paper were obtained theoretical expressions that show their dependence on some of the main operating parameters of vertical axis rotor harrows: working speed, speed of the harrow rotors and the number of knives that equip each rotor.The aim is to show which of the quality indices and the performance parameters of the work process have a real optimization potential for the work process. The results were used for superior statistical models that can obtain a higher degree of generality.

INTRODUCTION

The main objectives of the experimental research referred to the parameters that characterize the working process of rotary harrows with vertical axis rotors, to the relations between them and to the identification of the possibilities to optimize the working process using the found relationships [4].The aggregate studied in this paper already has an appreciable duration of exploitation. Over time, interest in rotary milling works has partially decreased, as some soils are affected beyond the permissible limit in terms of their texture (porosity, [3]). The efficiency of the experiments is materialized in the ability not to omit important operating parameters, at the same time to establish a hierarchy of the importance of operating parameters, so that some of the least important can be neglected [2].

MATERIAL AND METHOD

The material of this research consists in: rotary agricultural harrow with rods with vertical axis in aggregate with tractor of 80 HP and environmental conditions (soil, air, etc.) from the date of the experiments [7].

FIG. 1 TGARV UNIT IN OPERATION

The elaboration of the testing methodology is based on the systemic theoretical model of the garv work process. Also, considering the meteorological conditions, there is a large extension in time necessary to achieve the conditions of humidity, temperature, etc., according to the required variations. Given these difficulties and the extensive list of parameters, a number of credited parameters with major influence on the process were chosen.

In the experiments performed, several quality indices of the working process of vertical axis rotary harrows were studied. Qualitative work indices of germination bed preparation works characterize the degree to which the agrotechnical requirements imposed on the soil at the time of sowing [1]

Two categories of qualitative indices were considered: qualitative indices of tillage and qualitative economic indices[5]. The qualitative indices of tillage are: the degree of crushing and the degree of leveling. The economic indices that could be calculated are: energy consumption and productivity. If the economic indices can be predicted theoretically, the qualitative ones regarding the state of the processed soil are impossible to estimate in the absence of experimental data.[8].

The experiments performed for the determination of some official characteristics of the harrow with rotors with vertical axis and of the aggregate formed by the 80 hp tractor and this harrow, took place in the inma bucharest polygon.

The secondary tillage, which is carried out after plowing consists in fragmenting, crushing lumps and structural macro-aggregates of the soil, in achieving a uniform surface, ie a germination bed "loose, well crushed and uniform". The secondary work is in fact composed of several operations in relation to the type of soil, the cultivated plant, and the agricultural machinery used. Although these works are applied to facilitate sowing and then for the maintenance of agricultural crops, in most cases they lead in the long run to increase the vulnerability of the soil to degradation.

The main limiting factor is determined by excessive shredding of the soil in the first 10 cm[6,9].

The aggregates used in the experimental tests were two or two variants of the same aggregate:

- tractor unit - garv, tgarv .

-tractor unit -garvt, ie vertical rotary agricultural harrow with attached roller, tgarvt.

The measuring equipment was used for various types of measurements:

-simple equipment for measuring the degree of leveling, the degree of crushing, the skating of the tractor, the working speed .

-apparency for measuring soil moisture and penetration resistance .

- the apparatus for tensometric measurements (measuring and data acquisition and recording equipment) and the apparatus for measuring the moment at the socket and for the acquisition and storage of the data taken from it.

RESULTS AND DISCUSSIONS

The recordings of the experimental data were made for the tractor unit (80hp) and the rotary harrow and were of two types: digital recordings (recording the signals of tensometric marks that helped to calculate the traction forces and recording the moment at power) and on paper (consumption , working depth and width, degree of crushing and leveling, working speeds, rotor speeds and soil power at the power take-off) the traction force for the rotary agricultural harrow unit with attached roller - tractor 80 hp was also digitally recorded. The determination of the traction force values is based on a tensometric measurement system with three tensometric marks. Tensometric marks change their resistance depending on the specific deformation of the beam element on which they are glued (depending on the direction in which they are oriented to gluing) and indicate variations that are recorded. Calibrations were performed on the test stand for different known forces and at these force values the indications of the marks were read, which later, in the case of cause-effect biunivocity, allowed the calculation of traction forces knowing the recordings of tensometric marks in tests in camp.

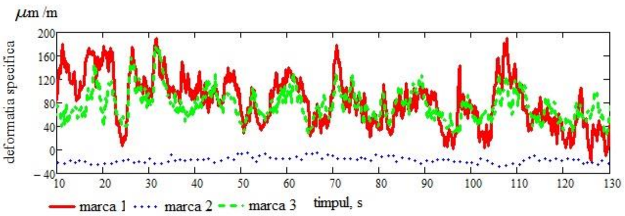

Fig. 2. Tensometric recording sequence obtained during experiment 1

The degree of crushing of the soil processed by the harrow with rotors with vertical axis was measured according to the number of knives used for constant speed and speed.

Table 1

The results of measuring the degree of crushing depending on the number of knives for each rotor.

Number knives / intervals mm	**2**	**3**	**4**
<20	26.8	33	31.3
20-50	56.4	57.3	58.2
50-100	16.8	9.7	10.5
>100	0	0	0

It is found that in the case of using three knives on the rotor it implies an intermediate behavior, between the two extreme cases.

The conclusion resulting from the direct examination of the experimental data can be summarized as follows: the degree of shredding is even better as the number of knives on the rotor increases.

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For the experimental determination of the traction force in various working regimes, works were carried out on distances of 50 m, varying the speed and number of knives, as well as the speed of the rotary harrow rotors with vertical axis rotors. The complete list of experiments is given in table 2, which also gives the average value of the traction force determined from the tensometric recordings made.

Table 2

Parameters of work experience for determining the traction force of the rotor harrow

Nr.	Rotor speed, rpm	Working speed, km / h	Number of knives on the rotor	Traction force, N
1	173	2.39	3	5170
2	173	2.39	4	7645
3	173	2.50	3	5802
4	173	2.50	4	6618
5	173	2.77	3	6434
6	173	2.77	4	7366
7	224	2.39	2	6673
8	224	2.39	3	6990
9	224	2.39	4	9480
10	224	2.50	2	4265
11	224	2.50	3	8604
12	224	2.50	4	6932
13	224	2.77	2	8952
14	224	2.77	3	9172
15	224	2.77	4	8670

The determination of the traction force was made by tensometric recordings on basic structural elements of the harrow

However, it is observed that the curve obtained and represented graphically in fig. 3, suggests the existence of a minimum point which is the optimal kinematic parameter that minimizes the traction force.

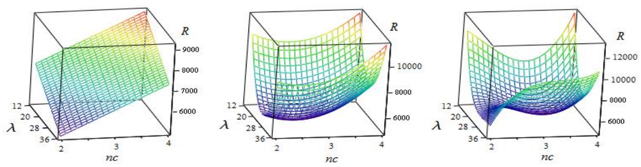

Fig.3 Variation of the tensile strength with the kinematic parameter (λ) and with the number of knives on the rotor (nc), in three interpolation variants: linear -left, square -center and cubic -right.

CONCLUSIONS

- The most influential parameters of the process are the working speed, the rotor speed and the number of knives that equip each rotor.

- There are a number of important parameters of the process, such as the specific resistance of the soil to deformation or the coefficient of resistance to deformation depending on the speed of the working member, also soil moisture and coefficients of friction, soil texture and structure, etc.
- There are a series of results of elementary statistical processing that signal the possible existence of optimal working points: fuel consumption per ha depending on working speed, specific fuel consumption per unit of productivity depending on working speed, resistance force at traction depending on the kinematic parameter, the functions that give the degree of crushing and the degree of leveling depending on various adjustable parameters.
- On the other hand, significant theoretical scientific advances seem to be very limited in quantity and quality in the absence of experimental research to support them. Thus, the experimental results must be repeated at certain periods of time due to the fact that environmental parameters, at least, undergo appreciable transformations.

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