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DETERMINATION OF AGRO-TECHNICAL INDICATORS IN SOIL TREATMENT IN ORCHARDS

Dimitar KEHAYOV, Rada POPOVA, Ivan ZAHARIEV

Agricultural University - Plovdiv, 12 Mendeleev Blvd, Department of Mechanization of Agriculture, Plovdiv, Bulgaria

Corresponding author email: dkechajov@mail.bg

Abstract

A field experiment was conducted with three tillage machines (disc harrow, soil tiller and cultivator) in an orchard in the area of Asenovgrad, Plovdiv region. The following agrotechnical indicators were observed - Soil loosening, pruning of weeds in the row spacing and maintenance of the set depth of work. It was found that the degree of loosening of the soil (85.5%) is highest in the milling machine. The disc harrow achieves maximum weed control (88.9%) and best maintains the set working depth (deviation 0.44 cm). An analysis of the obtained results was performed.

Key words: *disc harrow, tiller, cultivator, orchard, agrotechnical requirements.*

INTRODUCTION

The main task that has always faced science in fruit growing is to increase yields and improve the quality of fruit production. One of the factors that create the necessary conditions for solving this task is the system for maintaining the soil in orchards. The main goal is to destroy weeds in the order and row spacing of orchards and improve the structure of the surface soil layer.

Traditional for our country is tillage with disc harrows or cultivation. Each of these operations is applicable depending on the condition of the soil and especially on its moisture.

The main requirements for the operation of these machines, from the point of view of the agrotechnics of the cultivated crops, are crushing the soil and pruning the weeds (St. Dimov et al., 1969). Regarding these indicators, there are many studies of domestic and foreign scientists.

P. Panchev, L. Manov, Hr. Nankov (1983) observed the operation of V- and X-shaped disc harrows. They found that soil aggregates up to 50 mm in size represented 86.0 to 88.9% of the soil volume after twice passing through the cultivated field. Weed control varies from 66.8% in the first pass to 92.3% after the second pass with the working bodies of the harrow. Establish a relationship between the working width of the machine and the degree of fragmentation of the soil. With a smaller width of the used machine there is a better copying of the microrelief and from there better crushing of the soil and weeds control.

Significant is the contribution in this direction of St. Tirovska (1981), who studies the operation of a disc harrow with forced drive of the working bodies. Comparing the work in different operating modes, it was found that this machine is very effective when working on wetter soils. Under such conditions, the necessary agro-technical parameters of the cultivated soil are achieved with only one working stroke

R. Pal, J.P. Bhimwal, S. Choudhary (2015) investigated the operation of an offset soil tiller in the cultivation of orchards. They found that with increasing the depth of processing and changing the kinematic indicator increases fuel consumption and energy consumption

Bychkov V., Kadykalo G., Shevkun V. (2011) have analyzed the existing and future designs of machines for work in orchards. They have identified the trends that must be met by the technical means for processing the inter-row strips of perennial crops and their working bodies: the possibility to change the depth of cultivation; ensuring complete extraction of weeds from the soil from elements of the working body; preservation of the root system of the cultivated plant; automatic maintenance

of the working depth; reversible drive; ability to work in orchards and berry fields with different row spacing.

Gorovoy and Kharchenko (2018) found that the use of combined machines in tillage in the aisle of the garden allows to minimize labor costs and funds, to increase the culture of agriculture. The possibilities for combining technological operations are determined by the used systems of agriculture and soil cultivation, the pollution of the fields with weeds and their species composition, meteorological conditions, parameters of energy resources, agronomic, technical and economic and other factors. Tillage with simultaneous application of fertilizers along the contour of the root system of fruit trees in the rows of the garden reduces the number of technological operations from 5-7 to 1-2 during the growing season. Reducing the number of tillage leads to a reduction in fuel consumption for their implementation; reduces soil compaction; targeted fertilization increases yields.

In their study, M.JUGOVIĆ, T.JAKIŠIĆ, O.PONJIČAN (2020) observed and compared the operation of a harrow, a disc harrow and a milling machine. Comparing the work of the three machines, they found that the milling machine sprayed the soil more strongly.

Dallev M., I. Ivanov (2012) develop and study a machine that combines the principles of operation of a disc harrow and a milling machine. The authors found that depending on the inclination of the discs and the speed of movement, soil aggregates with a size of less than 25 mm, during one working stroke with the machine vary from 52.9 to 76.7%.

Kostadinov et al. (2016), G. Parkhomenko G. S. Tverdohlebov, A. Ponomarev (2016) systematize the machines used for tillage in fruit growing. The authors recommend that the control of the working bodies of the machines be performed automatically with a hydraulic tracking device. Only under this condition has a positive economic effect

MATERIALS AND METHODS

In the present work the object of observation are disk harrow BDTS-2,5; tiller FN-1,6 and vineyard machine UNLM-3,5 when working in orchards in the area of Asenovgrad municipality. The Table 1 provides a brief description of the plantation and soil condition:

Table 1 Characteristics of the cultivated field

№	Indicators	Value
1	Field dimensions, m length width	 560 400
2	Row spacing, m	4.5
3	Soil type	Alluvial-meadow
4	Soil moisture, %	22.5
5	Hardness, HB	44.8

The main indicators for the operation of the machines are:

Soil loosening (η) - is defined as the percentage of aggregates up to 50 mm in size relative to the total volume of the soil sample.

Destroyed weeds (δ) - The requirement is to destroy at least 90% of the weeds, and the inspection is performed in 5 places.

Maintaining set working depth (Δa) - In the present work, the machines are pre-set to work at a depth of 10 cm. The actual working depth is measured at 5 places along the working stroke of each machine. The difference between the average value and the set working depth gives the deviation from the working depth.

In order to determine whether the work of each of the three machines differs from the work of the others, a comparison of the average values is performed for each of the monitored indicators.

RESULTS AND DISCUSSIONS

The results of the experiments are systematized and arranged in the Tables 2-4.

Table 2. Soil loosening, %

Machine	Experience		Aggregates ≤ 50 mm, kg	Loosening, %
	№	Mass kg		
BDTS-2,5 disc harrow	1	4,25	2,68	63
	2	4,79	2,83	59
	3	5,06	3,59	71
	4	4,51	3,07	68
	5	3,98	2,83	71

average		**4,518**	**3,126**	**66,40**
mill FN-1,6	1	3,25	3,02	83
	2	4,81	4,09	85
	3	4,75	4,23	89
	4	3,99	3,17	79,5
	5	5,16	4,70	91
average		**4,392**	**3,842**	**85,50**
vineyard machine UNLM-3,5	1	5,01	2,40	48
	2	4,11	2,14	52
	3	3,86	2,08	54
	4	3,54	1,73	49
	5	4,83	2,80	58
average		**4,27**	**2,23**	**52,20**

The best for this indicator are the data for the soil tiller, and the worst - those for the vineyard machine. This is completely logical, since the working bodies of the cutter are active, with forced drive. During operation, they cut small particles of soil, which are further broken down into smaller units, by hitting the machine cover. Regarding weed control, the following results were obtained:

Table 3. Weed control

Машина Machine	Experience	Weeds before processing, number / m2	Weeds after processing, number / m2	Weed control, %
BDTS-2,5 disc harrow	1	34	4	88,23
	2	16	2	87,5
	3	27	5	81,48
	4	21	2	90,48
	5	30	1	96.67
average				**88,87**
mill FN-1,6	1	16	3	81,25
	2	25	4	84,00
	3	31	1	96,77
	4	30	6	80,00
	5	18	4	77,78
average				**83,96**
vineyard machine UNLM-3,5	1	27	6	77,78
	2	43	6	86,05
	3	22	8	63,64
	4	8	1	87,50
	5	16	3	81,25
average		**23,2**	**3,2**	**79,24**

As with loosening, the data for machines with active implements are better than those for cultivators. However, we should not forget the fact that in the presence of rhizome weeds it is not recommended to use disk and milling machines because by cutting the roots of weeds we increase their reproduction.

To maintain the set working depth, the following results were obtained:

Table 4. Deviation from the set working depth

Experience / Machine	1	2	3	4	5	average	Deviation from the depth, cm
БДТС-2,5	10,5	11	10	10	10,7	10,44	**0,44**
ФН-1,6	9,5	8	11	8,5	10,2	9,44	**1,04**
УЛНМ-3,5	11	12	10	11	10	10,8	**0,8**

The cutter has the largest deviation at the set working depth. It has the least weight and micro-irregularities more easily affect its vertical stability. Conversely, the disc harrow has the greatest weight, which contributes to its minimal deviation from the set working depth.
The comparison of the performance indicators for the used machines is graphically presented in Figures 1, 2 and 3.

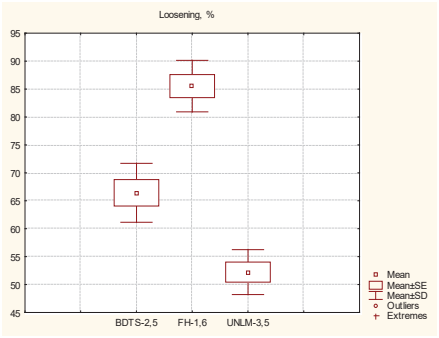

Figure 1. Loosening, %

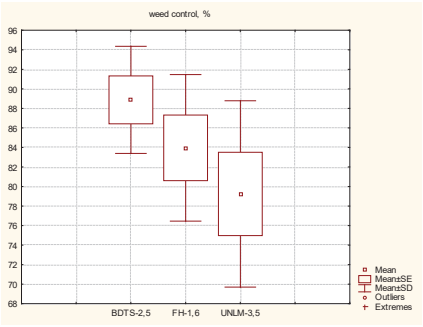

Figure 2. Weed Control, %

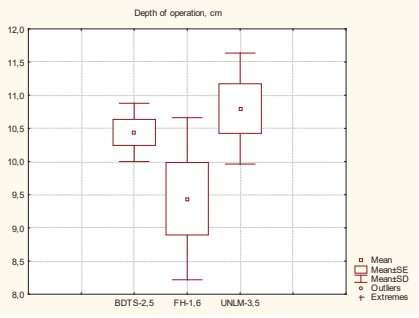

Figure 3. Depth of operation, cm

It can be seen that only with the indicator of soil loosening there is a proven statistical difference in the operation of the three machines, with the best value is the cutter. For the other two indicators, despite the difference in the average values, there is no proven statistical difference due to their large variation.

CONCLUSIONS

The following conclusions can be drawn from the performed experiments, the performed analyzes and summaries:
All three machines meet the agro-technical requirements for surface tillage in orchards. Only with the indicator of soil loosening there is a proven statistical difference in the operation of the three machines, with the best value is the cutter. For the other two indicators, despite the difference in the average values, there is no proven statistical difference due to their large variation.

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