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AGROMELIORATION ACTIVITY WITH A NEW MODEL OF SOIL CULTIVATING WORKING TOOL WITH INCREASED EFFICIENCY

Petya Genkova*, Manol Dallev

Agricultural University - Plovdiv, Bulgaria
***E-mail: petiagenkova@gmail.com**

Abstract

In this article, we consider innovative disc tillage machines and the introduction of soil improvers into them. Tillage and how to perform several operations with one pass of the machine is an increasingly relevant topic in the development of new agricultural machinery. Reducing tillage has a significant positive impact on soil quality, especially when applied purposefully and in accordance with specific conditions. Traditional methods of introducing soil improvers are often associated with additional tillage, which increases the cost and time of land preparation. The project addresses two major engineering challenges of modern agriculture: minimizing the number and intensity of tillage operations to reduce CO_2 emissions, energy costs and soil degradation, and delivering deficient micronutrients without additional tillage. The aim of this study is to evaluate the effectiveness of a new model of active disc tillage implement in applying a soil amendment to different soil types. The study focuses on the uniformity of distribution, depth of application and impact on soil agrophysical properties. The practical significance is that uniform application of the soil amendment can be achieved with minimal tillage, while maintaining biological efficiency and reducing harmful emissions due to the elimination of a second tillage. Therefore, today more than ever, solutions are being sought to restore and maintain soil health.
Keywords: agricultural machinery, incorporation, ameliorant, soil treatment

INTRODUCTION

Soil fertility is a key factor for sustainable agriculture, and its maintenance and improvement requires targeted agrotechnical and melioration measures. The transition to minimum tillage requires adaptation of agricultural techniques, weed control and careful management of crop rotation. But in the long term, this leads to healthier, more productive and more resilient soil. The present study examines the effectiveness of incorporating ameliorant by disc tillage implements (a new model) on a “plowed” soil background (GENKOVA et al., 2023). The aim is to assess the

influence of movement speed and depth of cultivation on the uniformity and quantity of the introduced meliorant. Fertilizers are substances that improve the physical, chemical and biological properties of the soil – it is a widely used method for restoring degraded soils, correcting acidity, salinization and improving the water regime. Modern technologies in soil tillage equipment offer the possibility of simultaneous incorporation of ameliorants during the main tillage, which increases efficiency and reduces agrotechnical loads. In recent years, more and more Bulgarian farmers have turned to conservation agriculture, applying technologies for minimum or no-tillage (Dallev, M. 2013). In the conditions of increasing climate change, soil degradation and rising production costs, more and more Bulgarian farmers are looking for sustainable solutions that will preserve resources and ensure stable yields. One of the most promising areas is minimum tillage, part of the concept of conservation agriculture. The choice of tillage methods (plowing, cultivation, disking, etc.) depends on the type of soil, climatic conditions and crops grown.

Soil improvers are substances that are added to the soil to improve its properties. They can be classified into several main groups:

- Physical improvers – such as sand, clay or organic materials used to correct the texture;
- Chemical improvers – limestone, gypsum, dolomite, which regulate pH, reduce toxicity and improve mineral composition;
- Organic improvers – manure, compost, green manure, which increase humus content and activate microbiological activity.

The application of improvers must be consistent with the agrochemical analysis of the soil in order to achieve maximum efficiency and avoid excessive accumulation of substances.

Combining targeted soil cultivation with rational application of improvers is essential for restoring and maintaining soil fertility. These practices not only improve the conditions for crop growth, but also contribute to the sustainable management of agricultural resources. In 2023, Bulgaria was visited by Dale Strickler, an American expert on regenerative agriculture and author of books such as “The Drought Resilient Farm”. He held seminars and demonstrations in which he emphasized that soil is a living organism that should be protected, not destroyed.

MATERIALS AND METHODS

The aim of the article is to study the introduction of ameliorant on a plowed soil background at two different speeds, at a depth of 2-8 cm and analysis in percentage content. The study includes eight variants of ameliorant incorporation at two speeds of movement (2.4, and 4.32 km/h) and four depths (2, 4, 6 and 8 cm). For each variant, the total weight of the soil with ameliorant and the ameliorant content in grams were measured, from which the percentage of ameliorant was calculated.

Table 1 Experimental data.

Speed (km/h)	Depth (cm)	Weight (g)	Meliorant (g)	Content (%)
2.4	2	938	22	25.00
2.4	4	2150	24	27.27
2.4	6	1448	20	22.73
2.4	8	989	22	25.00
4.32	2	796	47	53.41
4.32	4	1342	29	32.95
4.32	6	710	12	13.64
4.32	8	465	0	0.00

Experimental conditions:

- Location: Plovdiv region, Bulgaria
- Soil background: Ploughed
- Machine: Discs 1
- Travel speeds: 2.4, 4.32 km/h
- Cultivation depths: 2, 4, 6 and 8 cm

Procedure:

- The ameliorant is distributed evenly over the surface
- Soil cultivation is carried out with innovative discs at the specified parameters
- Samples are taken from the cultivated soil
- The total weight and content of ameliorant are measured
- The percentage content is calculated

The following regression relationship is derived.

For Discs 1 soil background plowing:

$M\% = 12.76a + 3.66V^2 - 4.98Va$

M - ameliorant in [%],

V – speed in, [km/h]

a – depth of the ameliorant in, [cm]

The results in Figure 1 a clear relationship between the speed of movement and the efficiency of incorporation. At the lower speed (2.4 km/h) the ameliorant is distributed evenly at all depths, suggesting good mixing with the soil. At the higher speed (4.32 km/h) surface accumulation (53.41% at 2 cm) and a complete lack of ameliorant at 8 cm is observed, indicating ineffective penetration into the depth.
This confirms that the speed of movement is a critical factor in the incorporation of ameliorants, especially when deep incorporation is aimed at..

RESULTS AND DISCUSSION

Effect of speed:At lower speed (2.4 km/h) a more uniform distribution of the ameliorant is observed, with a content between 22.73% and 27.27%.

At higher speed (4.32 km/h) the results are more unpredictable – from high content (53.41%) to complete absence of ameliorant (0%).

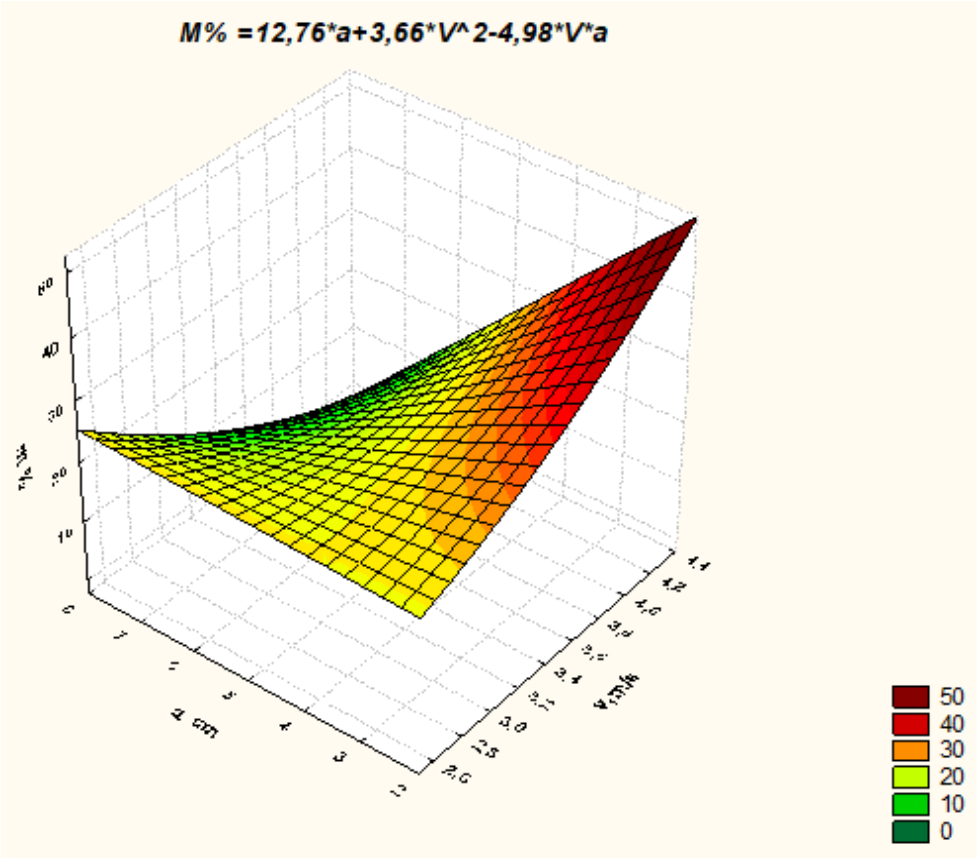

Fig.1 Relationship between the speed of movement and the efficiency of incorporation.

Effect of depth:

The highest ameliorant content is observed at 2 cm depth and 4.32 km/h – 53.41%, which suggests surface accumulation at high speed.

At 8 cm and 4.32 km/h – absence of ameliorant, which indicates that deep incorporation is ineffective at high speed.

At 2.4 km/h, the content is more stable at all depths, which indicates better incorporation.

The study on the incorporation of ameliorant with discs 1 on a "plowed" soil background shows that both the speed of movement and the depth of cultivation have a significant impact on the efficiency of the distribution of the ameliorant.

At a lower speed (2.4 km/h) a more uniform and stable ameliorant content is achieved at all depths studied.

At a higher speed (4.32 km/h) a highly varying content is observed, with the ameliorant completely absent at the deepest cultivation (8 cm).

CONCLUSIONS

The best results are achieved at a depth of 4 cm and a speed of ,(2.4 km/h) which suggests an optimal balance between mechanical processing and effective mixing of the ameliorant with the soil. Based on the data obtained, it is recommended to use a lower working speed and a moderate depth to achieve maximum efficiency in introducing ameliorants into the soil. This is essential for improving soil characteristics and the sustainability of agrotechnical measures.

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