



THE IMPACT ON SOME PHYSICO-MECHANICAL PROPERTIES OF SOIL PROCESSING USING THE VIBROCOMBINATOR IN FORESTRY NURSERY

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Abstract: Seedbed preparation for crop establishment (sowing) is one of the most important works in forestry nursery, as is done with high energy consumption and high costs. The quality of this work influences in large measure the germination of crop and the productivity that can be obtained per hectare. Therefore, at present, there is different equipment from the ones found in classical cultivation technologies, which in single pass can achieve tillage with minimum energy consumption, thus creating optimal conditions for sowing and for obtaining higher yield without soil degradation. These devices are called combinator. Of all the existing combinator, most performant are the vibro-combinators.

Introduction

The paper presents a study on the optimization of working regime of vibro-combinators based on environmental impact assessment for use in seedbed processing. Study presents a method to determinate some physical and mechanical proprieties before and after soil tillage works of aggregates consisting of tractor and vibro-combinators, in six parcels in the plains of the West of Romania. Vibro-combinators are machines for seedbed preparation. They are equipped with tools sustained by elastic suspension. The elasticity of supports facilitates the oscillations of working tool – elastic support assembly. This set has a natural mode shapes which corresponds to a natural frequency of vibration.

Generally, combinator consist of: **A.** a vibro-cultivator (cultivator for total processing of soil), composed of: frame 1, coupling device at the power source 2, wheels for limiting of working depth 3, soil loosening bodies 4

B a helix harrow, which consists of frame 5, two rodrotors 6, and horizontality adjustment system 7 (Fig. 1). Worldwide, more and more prestigious companies have incorporated into the range of products such vibro-combinators.

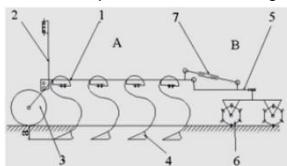


Fig. 1 General scheme of a vibro-combinator



Fig. 2 The prototype vibro-combinator SANDOKAN 2 equipped with the three types of active elements (GAMMA, DELTA1, DELTA2)

No. cr.	Characteristics	Unit	Values
1	Mass	kg	5670
2	Length in transport	m	6.6
3	Height in transport	m	3.95
4	Width in transport	m	2.93
5	Width of the gamma active parts, reversible chipper type	mm	35
6	Width of the delta 1 active parts, arrow type	mm	150
7	Width of the delta 2 active parts, arrow type	mm	250



Fig. 3 Geometrical models for the three active elements

Material and method

In order to obtain a global image on the impact of the new vibro-combinator (the prototype **SANDOKAN 2**) (table 1) in terms of the physical-mechanical properties of the soil, it was necessary to determine its properties before the passage of the equipment (in the state of the soil), and after its passage on all the six parcels and trials.

These parcels will be suggestively named (after the soil type): soil S1-soil S6; and the three types of active elements: **Gamma**, **Delta1** and **Delta2**.

The physical properties were determined by using the method of the cylinders with a constant volume of 100 cm³, carrying out six repetitions at different depth, from 6, 12 and 18 cm. The methods of analysis and interpretation of the results as well as the work procedure for the determination of the physical – mechanical properties are those indicated in the specialized literature.

Statistical analysis. All data were subjected to univariate three-way analysis of variance (ANOVA, P = 0.05) and done with KyPlot (Kyplot Version 5.0.2, <http://www.kyplot.software.informer.com>). The ANOVA factors were: Soil (soil type), h (depth), Device (active element) and their six order interaction.

Conclusions

The advantages of using vibro-combinators are: perfect preparation of seedbed in difficult working conditions and preservation of soil moisture. Such important factors can ensure fast, uniform and early germination of seeds, these requirements standing at the basis of abundant harvests. The research investigated the soil tillage performances and the environmental impact of several active elements of the vibro-combinators, at certain soil depths and soil types.

The multivariate analysis allowed to assess for each soil type which active elements performs both best soil tillage and environmental protection of the soils. From the technical point of view, the 6 cm depth is the most important to soil tillage for crop production. For this depth the active elements of the vibro-combinator: Delta2 and Delta1 are those that performs both best soil tillage and environmental protection of the studied soils.

Results and discussions

Multivariate analysis

To evaluate the vibro-combinators **soil tillage performances** were studied the variables: apparent density (g/cm³), total porosity (%) and soil compression (%).

To evaluate the **soil environmental impact** of the vibro-combinators were considered the variables: soil moisture (%) and water retention (m³/ha).

In order to assess simultaneously the vibro-combinators soil tillage performances and environmental impact, was involved the multivariate analysis: principal component analysis (PCA); multivariate analysis of variance (MANOVA, P = 0.05).

The PCA and MANOVA were done **separately for each soil types S1-S6**. The PCA method involved as input data the variables correlation matrix and between sample groups algorithm. The MANOVA algorithm used as input data the first two principal components (PCs) coordinates of the group samples. The group samples were described by the interaction factor **Device*h** (i.e. active elements*depth).

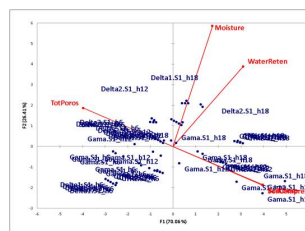


Figure 5. Interval plot for Soil 1 (from three-way ANOVA) for soil types (factor Soil), depth (factor h) and active elements (factor Device).

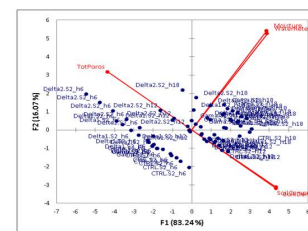


Figure 6. Interval plot for Soil 2 (from three-way ANOVA) for soil types (factor Soil), depth (factor h) and active elements (factor Device).

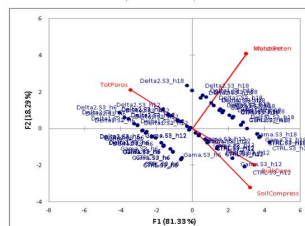


Figure 7. Interval plot for Soil 3 (from three-way ANOVA) for soil types (factor Soil), depth (factor h) and active elements (factor Device).

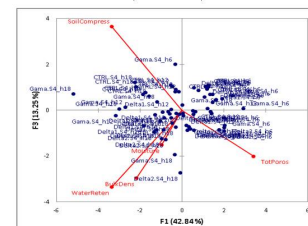


Figure 8. Interval plot for Soil 4 (from three-way ANOVA) for soil types (factor Soil), depth (factor h) and active elements (factor Device).

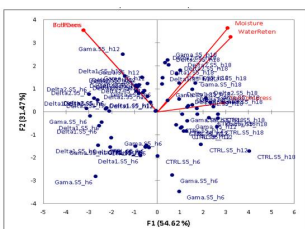


Figure 9. Interval plot for Soil 5 (from three-way ANOVA) for soil types (factor Soil), depth (factor h) and active elements (factor Device).

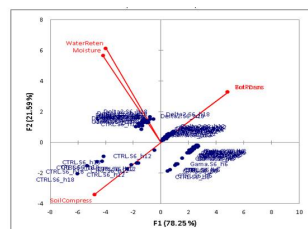


Figure 10. Interval plot for Soil 6 (from three-way ANOVA) for soil types (factor Soil), depth (factor h) and active elements (factor Device).