Current Trends in Natural Sciences
Vol. 13, Issue 25, pp. 152-161, 2024
https://doi.org/10.47068/ctns.2024.v13i25.018
Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521
Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

THE INFLUENCE OF THE CLASSIC AND CONSERVATIVE TILLAGE SYSTEM ON THE ECONOMIC EFFICIENCY OF THE PEA CROP IN 2023

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Abstract
This paper presents the results of the research carried out in pedoclimatic conditions at SCDA Pitești regarding the influence of tillage systems on the economic efficiency of the pea crop in the agricultural year 2023. The determination of economic efficiency was carried out according to the average physical yield for the year 2023, the yield value and the total cost of yield (cost of mechanical works + cost of materials). The pea yield in 2023 depending on the pedoameliorative and basic soil works varied from 1581 kg/ha to 3561 kg/ha. In the conventional deep plowed scarified soil system, the physical yield recorded an average value of 3561 kg/ha with a yield value of 7122 lei/ha. The yield cost was 4926 lei/ha, the net income 2196 lei/ha, obtaining a profitability value of 45%. In the variants with nonscarified soil, deep plowed, the physical yield was 3401 kg/ha with a value yield of 6802 lei/ha. The yield cost had the same values as in the variants with scarified soil. The net income recorded was 1876 lei/ha with a profitability of 39%. The conservative system sown directly, in the variants with scarified soil recorded an average yield of 1693 kg/ha and a yield worth of 3386 lei/ha. Regarding the yield cost, the price was 4679 lei/ha. Net income and profitability recorded negative values of -1293 lei/ha, respectively -28%. In the variants with nonscarified soil, the average physical yield was 1581 kg/ha, with an average value yield of 3162 lei/ha. The yield cost amounted to the same value as in the variants with scarified soil. The recorded net income was -1518 lei/ha, and the profitability -32%.

Keywords: economic efficiency, pea crop, tillage system

1. INTRODUCTION

The concept and application of conservative tillage methods have changed dramatically in recent decades in technological tillage systems, both globally and in Romania. Modern agriculture offers many opportunities to decrease soil interventions and so increase the profitability of agricultural production because of its intricate mechanization, which is based on a range of equipment and equipment for farming (Rusu et al., 2009).

For agricultural systems, conservation tillage can offer a number of advantages, including improved soil quality at the soil surface, reduced soil erosion and nonpoint pollution, reduced crop establishment time and energy consumption, and improved soil storage or retention of soil organic matter (Carter, 2005).

The concept of "economic efficiency" refers to estimating an economic activity's results in relation to the effort put forth in that activity. Since economic efficiency guarantees the absolute expansion

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of the result at the same level of effort, it is the primary qualitative component of economic growth. Profitability is a generic indicator of efficiency and is included in economic efficiency (Geamanu M, 2011).

As an economic tool that informs all of the company's decisions about how to manage its operations and interact with its business partners, profitability is the ability of an organization to generate profit from its economic activity while utilizing its resources. Because of this, it has grown to be a crucial metric for evaluating economic efficiency (Cojocaru, 2000).

Dry, green, or field peas, or Pisum sativum L., are some of the most widely grown, well-liked, and commercially significant legumes. Because of its high concentration of nutritional and bioactive components, pea eating has been linked to a variety of health advantages, and there is a growing emphasis on its potential as a functional food (Wu et. al. 2023).

It acts to direct the number of soil works or to perform, in a single pass, a multiplication of operations through minimum system works in order to reduce fuel consumption and to prevent increased soil subsidence through repeated machines passing on the ground that lead to the weakening of the physical properties of soil (Șimon et al., 2016).

2. MATERIALS AND METHODS

The purpose of the researches was to follow, within the classical and conservative system, some variants of tillage for the pea crop that are under the conditions of S.C.D.A. Pitesti, following the economic efficiency and their correlation with the yield obtained during the year 2023.

The main objective for achieving the research's goal was to establish the most efficient tillage system and to identify the basic works that are the best to the elements of technology applied in pea culture, in terms of economic efficiency in the pedoclimatic conditions of the SCDA Pitesti area.

The experience was stationary and was located in the experimental field of S.C.D.A. Pitesti, located at an altitude of 287 m, latitude of 44°51'30", 24°52'30″ in the year 2023, in a 3-year rotation (maize - peas - wheat).

The research soil is a typical luvosol, with a clayey texture (27.3% clay content in the 0–22 cm layer), moderate potassium supply (KAL = 85 mg/kg), moderate nitrogen and phosphorus supply (Nt = 0.133 % mg/, PAL = 32 mg/kg), and 2.26% humus content in the arable horizon. The pH of the soil is also 5.3

Table 1. Experimental scheme

Pedoameliorative soil works	Variant
Scarified soil	b1- deep plowed 28-30 cm;
	b2 - normal plowed 23-25 cm
	b3- disc
	b4 - sown directly
Nonscarified soil	b1- deep plowed 28-30 cm;
	b2 - normal plowed 23-25 cm
	b3- disc
	b4 - sown directly

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The field layout of the multifactorial experiment was that of subdivided plots and was carried out according to the method of completely randomized blocks with four repetitions.
Within the soil work systems, Factor A was represented by soil improvement works with scarified and nonscarified grades, and Factor B by basic soil works, made up of four graduations, namely: deep plowing, normal plowing, disc and direct sowing in stubble.
Scarification of the soil was carried out only at the establishment of the experience, in the fall of 2021, the pea crop benefiting from the effects of loosening in the second year of cultivation.
Sowing and maintenance of the crop were carried out according to the specific pea cultivation technology for heavy acid soils.
The biological material used was represented by the Avatar variety.
The experimental results were processed and analyzed using the Anova test.
The climatic conditions recorded during the research period at SCDA Pitesti were favorable for the growth and development of the pea crop (Dinuta et al. 2024).

3. RESULTS AND DISCUSSIONS

This paper presents the results of the research carried out in pedoclimatic conditions at SCDA Pitești regarding the influence of tillage systems on the economic efficiency of the pea crop in the 2023 agricultural year.
The average yield for the year 2023 was used to calculate the economic efficiency.
The findings of the study enable the selection of the best course of action for implementing the fundamental soil cultivation system in the technology, taking into account a number of variables, in order to maximize crop output by preserving the soil's fertility and improving its qualities (Zhichkina et al. 2021).
Yield costs were calculated considering the components of pea farming technology that have been examined.

Economic efficiency of pea crop, comparison of tillage systems

Conservative systems are characterized primarily by their ability to reduce fuel consumption through the elimination or reduction of technological works necessary to accomplish agricultural production at a lower cost. When conservative tillage practices are applied, not only is fuel economy increased, but soil deterioration and CO_2 pollution to the environment are also lessened. To include tillage variant into cultivated plant technology, one must ascertain the soil's degree of compatibility for various processing techniques.
Tillage, fertilization, plant protection and crop harvesting are the main agrotechnical factors that consume a lot of energy. These are the technological stages at which the costs of applying an optimal technology to agricultural crops can be reduced by introducing conservative systems.

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Table 2. Diesel consumption depending on the mechanical work performed

Classic system			Conservative system (no tillage - direct sowing)		
Tillages performed		Consumption l/ha	Tillages performed		Consumption l/ha
1	deep plowing tractor Arbos	28	1	herbicide treatment	1,3
2	disking	7	2		
3	tillages with combinator	4,5	3		
4	fertilize	1,5	4	fertilize	1,5
5	sowing	3,6	5	sowing with Mzuri 3m Etu farm	15
6	herbicide + insecticide treatment	1,3	6	herbicide + Insecticide treatment	1,3
7	harvested with combine Klass	15	7	harvested with combine Klass	15
8	transport- hour	4,5	8	transport- hour	4,5
	Total	65.4		Total	38,6
	Price 1l diesel=6 lei	392.4 lei			231.6 lei

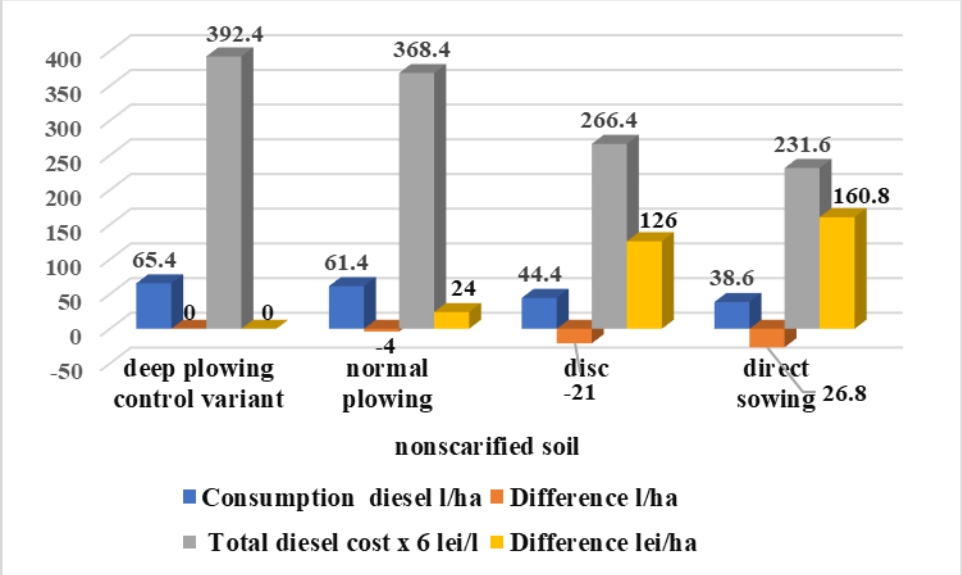

Figure 3. Diesel consumption (l/ha)

As can be seen from figure 3, the fuel consumption was influenced by the tillage method. Plowing, as the basic soil work, consumes the largest amount of fuel in a total crop system (28l/ha).

In the conventional (classic) tillage system, nonscarified, deep plowed, fuel consumption was 65.4 l/ha, and its cost was 392.4 lei/ha

In the classic tillage system, normal plowing, the fuel consumption was 61.4 l/ha, and the diesel cost was 368.4 lei/ha

In the system with minimum work (disc) tillage, nonscarified, diesel consumption was 44.4 l/ha, and its cost was 266.4 lei/ha.

In the conservative system sown directly, on nonscarified soil, fuel consumption was 38.6l/ha, and the value of diesel cost was 231.6 lei/ha.

By comparing the above data between tillage systems, it results in a higher fuel consumption in the classic system by 26.8 l/ha.

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Carrying out the scarification work in the year 2021, influenced the yield (higher values) in both tillage systems in the experimental field of the research station.
The scarification work increases the productivity of the tillage systems as follows:
In the classic system, deep ploughing, the increase in yield had values of 160 kg/ha, with a profit of 320 lei/ha and with a profitability of 6%.
In the classic system, normal plowing, the increase in yield had values of 328 kg/ha, with a profit of 656 lei/ha, and a profitability of 15%.
In the conservative system with minimum work (disc), the increase in yield was 357 kg/ha, with a profit of 714 lei/ha and a profitability of 2%.
In the direct sown conservative system, the value of the increase in yield was 112 kg/ha, achieving a profit of 224 lei/ha with a profitability of -4%.
The scarification process is expensive (523 lei/ha), but I think it should be done because it is very efficient economically and offers several benefits. It modifies the physical-chemical and biological conditions of the soil and establishes an aerohydric favorable regime, which supports plant growth and yield.

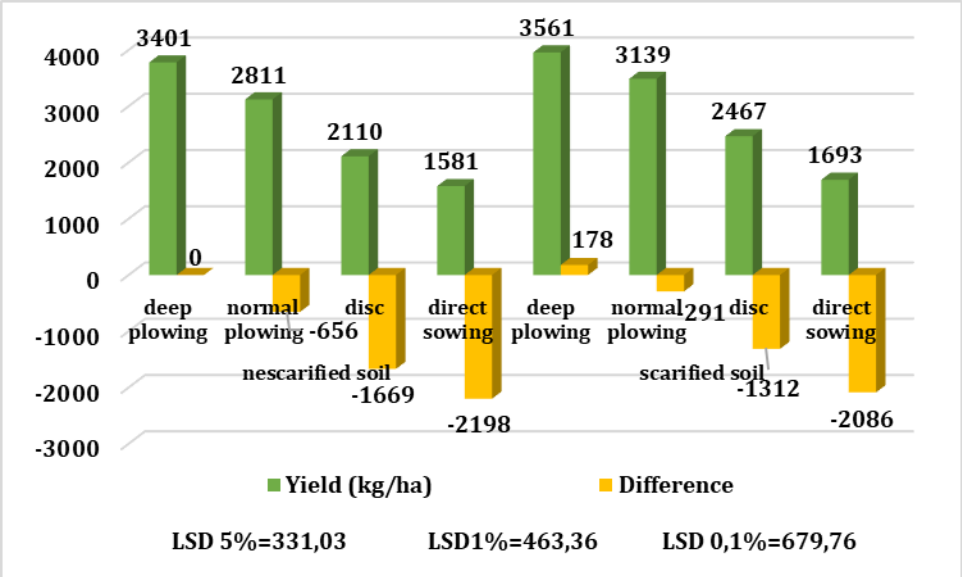

Figure 4. Grain pea yield (kg/ha)

The genetic potential of the variety and some aspects of growing technology influence pea grain production.
One measure of the pea crop's economic efficiency is its yield.
The pea yield in 2023 depending on the pedoameliorative and basic soil works varied from 1581 kg/ha to 3561 kg/ha.
The highest yield was obtained in the conventional (classical) system, the variant in which the main soil work consisted of scarification and deep plowing of 3561 kg/ha.
The lowest yield was recorded in the conservative system in the nonscarified soil variant directly sown with a value of 1581 kg/ha.

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Total costs for applying a technology depending on the basic tillage

In the conventional (classic) tillage system, the price per hectare for the required supplies (pesticides, chemical fertilizers, seed, etc.) is 3044.5 lei.

In the conservative system with minimum works (disc), the cost of the necessary materials is 3044.5 lei/ha.

In the conservative soil tillage system directly sown, the cost of materials is 3156.5 lei/ha and represents the largest part of the total culture technology.

Table 3. Profitability of the pea crop in the tillage variants

Tillage system	Tillages performed	Mechanical expenses	Cost of materials	Total technology	Earned income		Profit Advantage lei
					The yield obtained (kg/ha)	Value amount lei	
nonscarified							
Classical system	**deep plowing**	**1239**	**3044.5**	4283.5 +15% regia 642.5 **4926**	**3401**	**x 2 lei = 6802**	**1876**
	normal plowing	**1215**	**3044.5**	4259.2 +15% regia 638.8 **4898**	**2811**	**5622**	**724**
Conservative system (minimum tillage)	**disc**	**901**	**3044.5**	3945.5 +15% regia 591.8 **4537.5**	**2110**	**4220**	**-317.3**
Conservative system (no tillage)	**direct sowing**	**912**	**3156.5**	4068.5 +15% regia 610.3 **4678.8**	**1581**	**3162**	**-1516.8**
scarified							
Classical system	**deep plowing**	**1239 +**	**3044.5**	4283.5 +15% regia 642.5 **4926**	**3561**	**7122**	**2196**
	normal plowing	**1215**	**3044.5**	4259.2 +15% regia 638.8 **4898**	**3139**	**6278**	**1380**
Conservative system (minimum tillage)	**disc**	**901**	**3044.5**	3945.5 +15% regia 591.8 **4537.5**	**2467**	**4934**	**396.5**
Conservative system (no tillage)	**direct sowing**	**912**	**3156.5**	4068.5 +15% regia 610.3 **4678.8**	**1693**	**3386**	**-1292.8**

Referring to the total expenses for the application of a tillage system, we observe from table 3 that in the classic system the total cost is 4926 lei/ha, and when applying the conservative system (direct sowing) the total cost is reduced by 5.1%, to 4678.8 lei/ha, in nonscarified soil. When applying the conservative system with minimum works (disc), the total cost was 4537.5 lei/ha, 7.8% lower than in the conventional system of soil works.

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The difference between the total costs for the application of a soil work system is mainly due to the higher costs of the mechanical work performed.

Table 4. Total cost of soil works system

Convențional Classic system			**Conservative system (no tillage - direct sowing)**		
Tillages performed		Cost price (lei/ha)	**Tillages performed**		Cost price (lei/ha)
1	Scarified with MAS 5 2021	523 NU	1	Nonscarified	-
2	**deep plowing tractor Arbos**	480	2	herbicide treatment	59
3	disking	142	3		
4	tillages with combinator	50	4		50
5	fertilize	109	5	fertilize	
6	sowing	131	6	sowing with Mzuri 3m Etu farm	80E+TVA 476 lei
7	herbicide + insecticide treatment	59	7	herbicide + Insecticide treatment	59
8	harvested with combine Klass	177	8	harvested with combine Klass	177
9	transport- hour	91	9	transport- hour	91
+	**Total lei Mechanical expenses**	**1239**	+	**Total lei Mechanical expenses**	**912**
	Cost made with materials	**3044.5**		**Cost made with materials**	**3156.5**
	Staff cost 1 ZO x 200 lei (2 zile)	400		**Staff cost** 1 ZO x 200 lei (2 zile)	400
	Seed: 386kg/ha x4,7lei=1814.2 lei/ha	1814.2		**Seed:** 386kg/hax4,7lei=1814.2lei/ha	1814.2
	Fertilizers: NPK20.20.0. 300kg/ha x 1,234lei=370,2lei	370,2		**Fertilizers:** NPK20.20.0. 300 kg/ha x1,234 lei =370,2 lei	370,2
	Herbicides: Dual Gold 1,5l/ha x 135lei=202,5lei Pulsar 40 1l/ha x233 lei = 233lei Insecticides (Faster Gold 150ml/ha 1 l =164 lei 150 ml = 24,6 lei	435,5 +24,6 **460,1**		**Herbicides**: Dual Gold 1,5l/ha x 135lei=202,5lei Pulsar 40 1l/ha x233 lei = 233lei Round up Classic 2l x 56 lei Insecticid(Faster Gold 150ml/ha 1 l =164 lei 150 ml = 24,6 lei	202,5 233 **572,1** 112 24,6
	Total Lei nonscarified soil	**4283.5 lei**		**Total Lei nonscarified soil**	**4068.5 lei**
+	**Indirect Cost Regia 15%**	**642.5**	+	**Indirect Cost Regia 15%**	**610.3**
	TOTAL EXPENSES	**4926.0 lei**		**TOTAL EXPENSES**	**4678.8**

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Figures 5 and 6 present data on the profitability elements of the pea crop, in the variants with pedoameliorative soil works (nonscarified soil-scarified soil) both in the classical system (conventional) and in the conservative system with minimum works (disc) and direct sown.
In the variants with nonscarified soil, deep plowed, the physical yield was 3401 kg/ha with a value of 6802 lei/ha. The yield cost had the same values as in the variants with scarified soil. The net income recorded was 1876 lei/ha with a profitability of 39% (Figure 5).

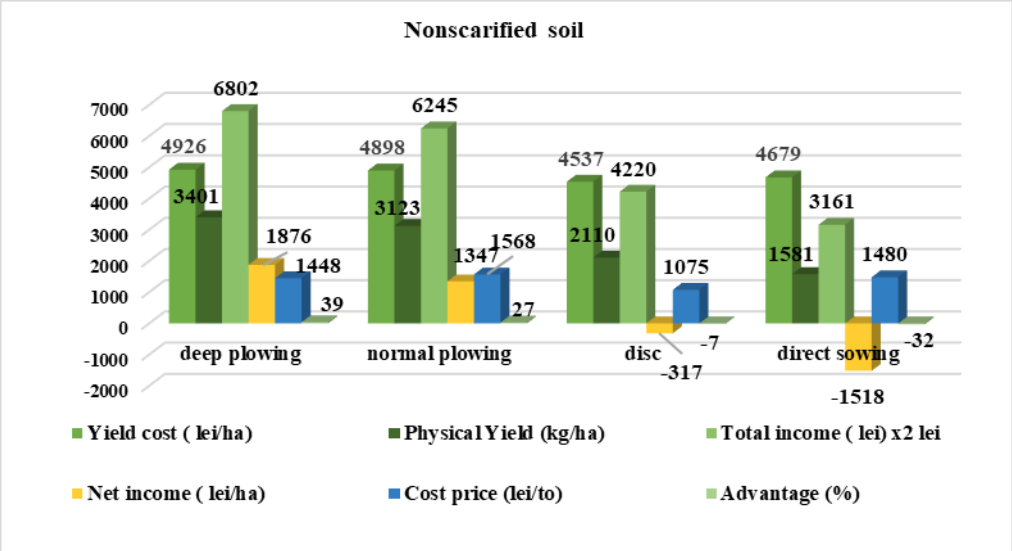

Figure 5. Economic efficiency of the pea crop in the tillage system – nonscarified soil

In the variants with nonscarified soil, normal plowing, the physical yield was 2811 kg/ha with a value of 5622 lei/ha. The yield cost was 4898 lei/ha. The net income recorded was 1347 lei/ha with a profitability of 27%.
The conservative system, with minimum works (disc) in the variants with nonscarified soil, recorded an average yield of 2110 kg/ha and a yield value of 4220 lei/ha. The yield cost was 4537 lei/ha. Net income and profitability recorded negative values of -317 lei/ha, respectively -7%.
In the variants with nonscarified soil, the average physical yield was 1581 kg/ha, with an average value yield of 3162 lei/ha. The yield cost amounted to the same value as in the variants with scarified soil. The net income recorded was -1518 lei/ha, and the profitability -32%.
In the conventional scarified soil system (figure 6), deep plowed, the physical yield recorded an average value of 3561 kg/ha with a value of 7122 lei/ha. The cost was 4926 lei/ha, the net income 2196 lei/ha, obtaining a profitability value of 45%.
In the conventional scarified soil system, normal plowing, the physical yield recorded an average value of 3139 kg/ha with a value of 6278 lei/ha. The yiled cost was 4898 lei/ha, the net income 2078 lei/ha, obtaining a profitability value of 42%.

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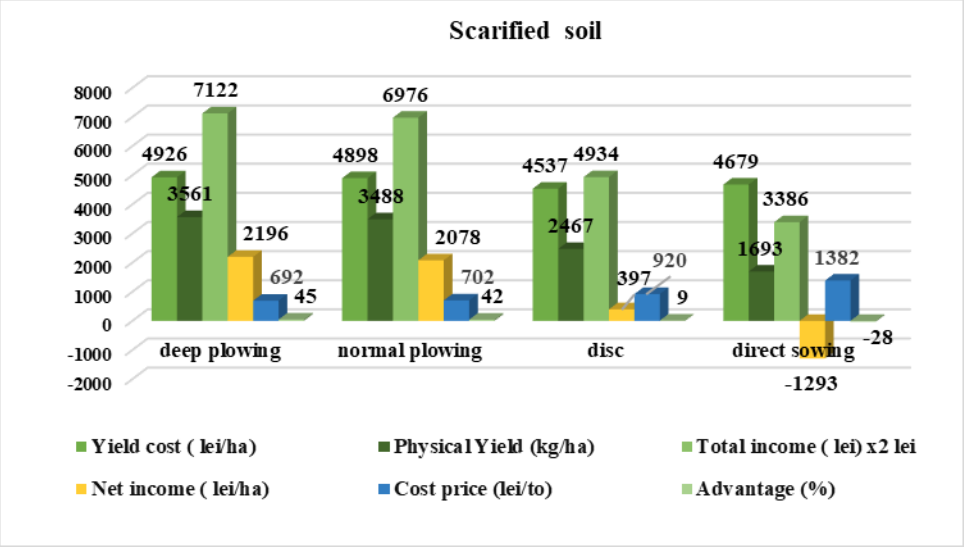

Figure 6. Economic efficiency of the pea crop in the tillage system – scarified soil

The conservative system, with minimum works (disc) in the variants with scarified soil, recorded an average yield of 2467 kg/ha and a value of 4937 lei/ha. Regarding the yield cost, the value was 4537 lei/ha. Net income and profitability recorded values of 397 lei/ha and respectively 9%.
The conservative system sown directly, in the variants with scarified soil recorded an average yield of 1693 kg/ha and a yield value of 3386 lei/ha. Regarding the cost, the value was 4679 lei/ha. Net income and profitability recorded negative values of -1293 lei/ha, respectively -28%.
Following the results obtained, we found that the economic efficiency within the conventional (classical) system registered positive values, compared to the conservative direct sown system.
The results of the research make it possible to choose the optimal solution for the application of the basic soil work system in the pea cultivation technology, depending on a set of factors, to increase the yield of the crop by optimizing the soil properties and to ensure the preservation of its fertility.

4. CONCLUSIONS

Following the research, it was found that the conventional (classical) system with pedoameliorative and basic soil work offered the best conditions for the formation of pea yield in 2023.
The highest yield value of 3561 kg/ha was obtained in the classic tillage system, scarified soil variant, deep plowing.
The lowest yield value of 1581 kg/ha was obtained in the conservative tillage system, the nonscarified soil variant, direct sowing.
Carrying out the scarification work in the year 2021, had influenced the yield (higher values) in the tillage systems of the experimental field of the research station.
Referring to the results obtained in 2023 at SCDA Pitesti, regarding the economic efficiency of the pea culture within the conventional (classical) system, higher values were recorded, compared to the conservative direct sown system.
The economic efficiency of the 2023 pea crop from SCDA Pitesti was not efficient in all tillage system variants of the experience.

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The consumption of fuel (diesel) was influenced by the tillage method and is lower in the conservative direct sown system compared to the classical conventional one with 28.6 l/ha and its value of 171.6 lei/ha.

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