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## AGROTECHNICAL AND ECONOMICAL ALTERNATIVES FOR PEA CULTURE IN TURDA AREA

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**Abstract:** *The aims of this experiment are to evaluate the yield of pea cultivated in conventional and reduced tillage and the economy of minimum tillage systems application. Soil is the primary factor determining the plants yield of a particular area. Yield of pea is determined by multiple factors and the yield variability may be difficult to predict. The experimental factors are: factor A-the experimental years 2014 and 2015, factor B-three tillage systems: conventional, minimum and no tillage. In 2014 was obtained a higher production than in 2015, with a very significant difference. Pea production decreases after applying conservative systems, with 204 kg/ha in minimum system and 611 kg/ha in no tillage system. Fuel consumption used for to perform basic works is higher in the variant to which the soil is plowed compared with minimum tillage systems. The highest costs in achieving the yield/1 ha are recorded in the classical tillage variant, with 12.78% respectively 19.31% higher than in minimum tillage systems. Seedbed preparation is the element of the culture technology where by applying minimum tillage systems can reduce the cost, in no tillage system this technological stage being eliminated.*

**Keywords:** *climatic condition, economy, pea, tillage systems, yield.*

**Clasificare JEL:** Q 01, Q15, Q16.

### INTRODUCTION

Climate change is one of the most important factors that influence agricultural production and food, by blocking the natural energy flows of the plant systems (Berca, 1998).

Tillage is considered to be one of the basic elements modifying soil physical, chemical and biological properties and determining the germination, growth and development of both cropped vegetation and weeds (Haliniarz, 2014).

The most agro-technical factors (fertilization, protect plant and tillage) are highly energy-consuming and therefore solutions are sought after that would reduce production expenditures (Woźniak, 2013).

Peas is a culture with great agronomic importance, helping to develop the agricultural systems through nitrogen fixation (Șimon et al., 2014). Seed yield in field pea is a quantitative trait affected by many genetic and environmental factors (Ranjan et al., 2006) such as temperature, precipitations or soil type and moisture.

The advantages of reduced tillage over conventional tillage include the control of soil erosion (Allmaras et al., 1973), enhanced crop performance, soil water conservation (Griffith et al., 1986), reduced time of work and reduced labor requirements (Frye et al., 1981; Phillips, 1984).

Disadvantages include the greater weed control problems and herbicide dependency (Standifer and Beste, 1985), long-term reduced tillage leads to the accumulation of weed seeds in the topsoil (0-10 cm), which has a significant influence on weed infestation and increased the pest problems.

The conservation of soil fertility requires a tillage system that optimizes the plant needs in accordance with the soil modifications, that ensures the improvement of soil features and the obtainment of big and constant crops. (Rusu and al., 2009).

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## MATERIALS AND METHODS

The experiment was conducted in the period 2014-2015 at the Agricultural Research-Development Station Turda (ARDS), on soil type vertic faeozem, pH neutral, with loam-clay texture, medium humus content, good supply in mobile phosphorus and potassium.

Pea was sown in the third decade of the March in the quantity of 100 seeds per 1 m<sup>2</sup>, with the distance between rows 18 cm with Gaspardo Directa 400 drills.

The experimental factors were: factor A - the experimental years: A<sub>1</sub>-2014, A<sub>2</sub>-2015; factor B - Tillage system: B<sub>1</sub>-Conventional tillage system included ploughing at 25 cm depth after harvest of the previous crop and processing with rotary harrow before sowing; B<sub>2</sub>-Minimum tillage system involved the use of a chisel at 25 cm depth after harvest of the previous crop and processing with rotary harrow before sowing; B<sub>3</sub>-No tillage system included the direct sowing.

To evaluate the yielding of pea cultivated in the three tillage systems we are studied one genotype of afila pea: Tudor. Pea was grown in a crop rotation for 3 years, the precursory plant being winter wheat.

After sowing it was made one treatment with glyphosate (4l/ha) in the three systems. Monocotyledonous and dicotyledonous weeds control was made with Tender (1.5 l/ha), Pulsar (1.0 l/ha) and Agil (1.0 l/ha) herbicide in a weeds rosette phenophase.

For pea protection against pests, at the early flowering stage of plants it was made a treatment with Calypso (0.1 l/ha) insecticide and at the 10 days after early flowering it was made another treatment.

Results achieved were elaborated statistically with the method of analysis of variance and setting up the Least Significant Difference - LSD - (5%, 1%, and 0.1%) (ANOVA, 2015).

The climatic condition of the years 2014 and 2015 were presented according to the Weather Station ARDS Turda (Table 1). During the last 55 years, the annual means of temperature were 9<sup>0</sup>C and total amount of precipitation were 520.6 mm. The temperatures recorded in the two years studied are higher than the average of 57 years. In 2015 rainfall was lower than in 2014, and their absence in optimum moments for culture development has resulted in significant loss of yielding. In 2014 the temperatures and rainfall were beneficial to the crop of peas, yield being the result of the interaction optimum climatic conditions.

Table 1. Thermic and pluviometric regime in the vegetation period of pea culture, Turda 2014-2015

Years		Months					Average or amount
		March	April	May	June	July	
Air temperature (°C)	2014	8.8	11.4	15.1	18.5	20.4	14.8
	2015	5.5	9.6	15.8	19.4	22.3	14.5
	Average 57 years	4.1	9.8	14.7	17.7	19.6	13.2
Precipitation (mm)	2014	23.1	72.0	66.2	48.4	144.4	354.1
	2015	12.8	32.2	66.0	115.7	52.2	278.9
	Average 57 years	23.1	44.7	67.7	84.5	76.7	296.7

## RESULTS AND DISCUSSIONS

Yields obtained in minimum tillage system are smaller compared with conventional tillage system, but the long-term benefits obtained (reduction of air pollution, reduction wind and rain erosion, economy of fossil fuels non-renewable, conservation of soil structure and fertility) are the most important.

Climatic conditions from those two experimental years had a great influence on the yield achieved, statistically in 2014 the yield was higher, the difference from the average of the two years

(control variant) being very significant and in 2015 difference from a control variant was very significantly negative (Table 2).

Table 2. The influence of the experimental years on the pea yield

Year	Yield (kg/ha)	Difference
Average (control variant)	2736	-
2014	3113***	376
2015	2360 <sup>000</sup>	-376
LSD (p 5%) 73	LSD (1%) 168	LSD (p 0.1%) 373

A great influence on the yield has the soil tillage system, following the application of unconventional tillage systems register a decrease in yield of 204 kg/ha at application of the minimum tillage system, respectively 611 kg/ha at application of no tillage system, differences from the conventional tillage system (control variant) is very significant (Table 3). The yielding of plants cultivated in no-tillage systems is, generally, slightly lower than of plants from conventional tillage systems. The conservation tillage increases weeds infestation and consequently lowers yield.

Table 3. The influence of the tillage system on the pea yield

Year	Yield (kg/ha)	Difference
Conventional tillage system (control variant)	3008	-
Minimum tillage system	2804 <sup>000</sup>	-204
No tillage system	2397 <sup>000</sup>	-611
LSD (p 5%) 73	LSD (1%) 102	LSD (p 0.1%) 144

Agrotechnical foactors (tillage, fertilization, plant protection) are highly energy consuming and therefore are sough solution to reduce costs. In the case of fertilization through the introduction of legumes in crop rotation is achieved an economy, the legumes need small amounts of fertilizer. In terms of the quantity of fuel used for tillage, by introducing minimum systems reduces the number of works, consequently decreases fuel consumption used. Fuel consuming is influenced by some factors: soil, working depth, weather, therefore it is recommended that tillage to be performed in the optimal climate conditions. At the application of conservative systems is achieved a fuel economy of 22,3 l/ha in the case of minimum tillage system and 23 l/ha in the no tillage system (Table 4).

Table 4 . Fuel consumption depending on the tillage

Tillage	Consumption (l/ha)	Percent (%)	Economy (l/ha)
Plowing (control variant)	28	100	-
Processing with chisel	5.7	20.3	22.3
Direct sowing	5	17.9	23

For effective implementation of minimum tillage systems in economically and environmental suitability is necessary to know the pretability level of the soil at different tillage systems.

After the experiences made by Köller (2003), which compared several systems of tillage, it can make a saving of 73% of the fuel needed by applying of the direct sowing system and in mininum tillage systems is recorded lower fuel consumption by up to 19%, in the version with chisel plough compared to conventional tillage system by ploughing following experiments conducted by Stănilă

et al., (2008), in our experience is saving 79,7% of the fuel consumed in the minimum tillage system and 82.1% in the no tillage system.

Basic work, ploughing, consumes the largest amount of mechanical energy, representing 35% of the total energy consumed for the execution of the vegetal production of plant (Berca, 1999). The economy achieved by reducing the amount of fuel per unit area is an indicator of the efficiency at the minimum tillage systems application.

Reducing production costs can be a major contributor to maximising output per unit area and savings made during the crop establishment phase can be a vital part in cost reduction (Knight, 2004).

Table 5. Costs made at the soil tillage systems application

Conventional tillage system		Minimum tillage system		No tillage system	
Tillage performed	Cost/ha (RON)	Tillage performed	Cost/ha (RON)	Tillage performed	Cost/ha (RON)
Plowing	168	Processing with chisel	34.2	-	-
Processing with harrow	34.2	Processing with harrow	34.2	-	-
Sowing	30	Sowing	30	Sowing	30
Sprayer	9.6	Sprayer	9.6	Sprayer	9.6
Treatments applying	19.2	Treatments applying	19.2	Treatments applying	19.2
Total works	261	Total works	127.2	Total works	58.8
Materials	786	Materials	786	Materials	786
Total	1047	Total	913.2	Total	844.8

At the application of minimum tillage systems it is realizing an economy of 133.8 ron/ha (12.78%), and at the application of no tillage system, the economy is 202.2 ron/ha (19.31%) compared to classical tillage system, if we refer to all the technological elements involved in yield obtained per 1 hectare (Table 5).

The highest costs of technology (786 ron/ha) are recorded in case of necessary materials (insecticides, herbicides, seeds), the costs being equal in the three systems, the largest economy are realized in fact by reducing the amount of fuel.

At the minimum application is realized an important saving of fuels, lubricants, a lower wear of the machine and reduce the human work consumption.

Table 6. Percentage evaluation of the most important technological works according to tillage system

Technological works	Tillage system		
	Conventional tillage (%)	Minimum tillage (%)	No tillage (%)
Seedbed preparation (including seeding)	47.40	27.60	10.40
Total treatments	9.80	13.50	16.70
Harvesting	42.80	58.90	72.90

By percentage reporting of the most important technological steps to the total costs of technology culture at pea, as seen from table 6, in conventional tillage system predominated the consumption in the stage of preparing the seedbed (including sowing) compared with the minimum tillage systems where this percentage decreases depending on the number of works.

In minimum tillage systems were registers the highest costs in the harvesting of the crop, the stage has the same costs in all three systems, but that percentage is change at the application of the minimum tillage systems in relation to total expenditure.

In technology of pea culture there are elements where applying minimum tillage systems can reduce costs and working time. Seedbed preparation is the element of the culture technology where by applying minimum tillage systems can reduce the cost and time, and fertilization is the element in which is possible to make the economy through the use of legumes in crop rotation.

For seedbed preparation costs geting at 232.2 ron/ha in conventional tillage system and 98.7 ron/ha in minimum tillage system, in no tillage system this technological stage being eliminated.

## CONCLUSIONS

The favorable climatic conditions of the 2014 influenced the yield of peas, the differences being very significant positive compared to the average of the two years, while the 2015 has registered very significant yield declines.

Soil tillage system affects the yield, in unconventional tillage systems (minimum tillage and no tillage) is obtained a lowering of values with very significant differences compared to the classical system.

In the system with a minimum tillage is savings of 133.8 ron/ha respectively 202.2 ron/ha as compared to the classical system, if we relate to all factors involved in technology, compared with the conventional system, where is recording a cost of 1047 ron/ha.

After applying minimum tillage systems reduces the amount of fuel used, at the tillage soil with chisel using only 20.3% of the total fuel required in the case of plowing, and at directly sowing is register a low percentage of 17.9 compared to plowing.

By reducing or eliminating the number of works required to prepare the seedbed is achieved significant savings in fuel and time.

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