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INFLUENCE OF SOIL TILLAGE SYSTEMS ON SOME CHARACTERISTICS MORPHO-PRODUCTIVE AND YIELD TO PEA

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Abstract

Conservative tillage techniques are widely used to preserve soil structure and fertility, the use of legumes in crop rotation system help improve soil quality and growth of culture yield which are in rotation.This paper evaluate the yielding of pea cultivated on three different conditions of tillage: conventional tillage, minimum tillage and no tillage were studied for four genotype of afila peas: Tudor, Dora, Bellmondo and Camilla. The experiment was conducted in the years 2014-2015on soil type phaeozem, located in the Transylvanian Plain, Romania.Climatic conditions have a large influence on production, the differences obtained in those two years are being very significant, in 2014 was obtained an average production of 3161 kg/ha compared with 2015, respectively 2380 kg/ha. In conventional tillage system soil has achieved a higher production than in conservative systems, the difference being 163 kg/ha compared to the minimum system and 813 kg/ha compared to the no tillage system. Production differences exist in the case of varieties used in the experiment, varieties Bellmondo and Camilla has good production304 kg/ha respectively 133 kg/ha compared to the average of varieties. Significant values of correlation between morph-productive characters are in the number of plants/m^2, the number of pods/m^2 and number of grain/m^2.

Key words: *pea, conventional tillage, minimum tillage, no tillage, yield.*

INTRODUCTION

The whole planet is facing global warming, population had to adapt to climate change, and the most important element is the need for measures to reduce emissions of greenhouse gases. Establishing a system of sustainable management in agriculture can be achieved by adapting tillage on soil at climatic conditions and efficient use of nutrients by including legumes in the rotation.

Soil tillage is of great importance in providing proper conditions for plant germination emergence (Sprague, 1986; Gajri et al., 2002; Hakansson et al., 2011) and growth, is a key element of soil environment management (Małecka et al., 2012).

The objective of tillage is to provide optimal conditions for plants growth (Morris et al., 2010; Haliniarz et al., 2014), crop yield in inversion tillage (Rice, 1983; Lafond et al., 2006) and non-inversion tillage depends by many genetic and environmental factors (Ranjan et al., 2006; Espósito et al., 2009) such as temperature, precipitations or soil type and moisture,that affect one another (Jones et al., 2006) and whose effects are difficult to predict (Marin et al., 2012; Rusu, 2014).

In dry regions, the conventional tillage system with ploughing may be replaced by conservative tillage (Derpsch, 2005) that increases crop productivity and in a long-term perspective improves soil properties (Hemmat and Eskandari, 2004).The yielding of plants cultivated in no-tillage systems is, generally, lower than of plants from conventional tillage systems (Woźniak, 2013).

Tillage is considered to be one of the basic elements modifying soil physical, chemical and biological properties and determining the germination, growth (Simon et al., 2015) and development of plant vegetation.

It is estimated that approximately 40-60 million metric tons of atmospheric nitrogen is fixed by cultivated legume plants annually (Smil, 1999), which is important for agriculture and for the environment because nitrogen fixation (Reiter et al., 2002) can supplement the use of synthetic nitrogen fertilizers (Phillips, 1980) which require a large amount of energy input during production that can contribute to environmental pollution.

Pea as a major food legume has the capacity for enhanced nitrogen fixation (Poudel et al., 2001) and CO_2 (Drinkwater et al., 1998) capture, which may partially offset growth reduction associated with higher temperature (Yadav et al., 2011), shorter growing season, and periods of drought.

The aim of this paper is to evaluate the yielding of pea cultivated on three different conditions of tillage: conventional tillage, minimum tillage and no tillage.

MATERIALS AND METHODS

The experiment was conducted in the years 2014-2015 at the Agricultural Research Development Station Turda (ARDS Turda), experimental field are located in the Transylvanian Plain, on soil type phaeozem, with pH neutral, loam-clay texture, medium humus content, good supply in mobile phosphorus and potassium.

The experimental factors were:

A - Conventional tillage system included ploughing at 25 cm depth after harvest of the previous crop and processing with rotary harrowbefore sowing.

B - Minimum tillage system involved the use of a cultivatorat 25 cm depth after harvest of the previous crop andprocessing with rotary harrow before sowing.

C - No tillage system included the direct sowing.

To evaluate the yielding of pea cultivated in the three tillage systems were studied four genotype of afila peas: Tudor, Dora, Bellmondo and Camilla. Pea was grown in a crop rotation for 3 years, the precursory plant being winter wheat.

After sowing it was made one treatment with gliphosate (4 l/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.

Pea (*Pisum sativum* L.) was sown in the thirddecade of April, in the quantity of 100 seeds per m^2in row spacing of 18 cm with Gaspardo Directa 400drills.

The climatic condition of the years 2014 and 2015 are presented according to the Weather Station ARDS Turda (Table 1). During the last 55 years, the annual means of temperature were 9^0C and total amount of precipitation were 520.6 mm. The temperatures recorded in the two years studied were 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 production. In 2014 the temperatures and rainfall were beneficial to the crop of peas, productions being the result of the interaction optimum climatic conditions.

Results achieved were elaborated statistically with the method of analysis of variance and setting up the Least Significant Difference - LSD - DL (5%, 1%, and 0.1%) (ANOVA, 2015). Correlations between the analyzed parameters were evaluated with the Pearson's correlation coefficients.

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

Years		Months					Average or amount
		March	April	May	June	July	
Air temperature (^{0}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

Due to favorable climatic condition in the vegetation period of the year 2014 it was obtained high productions over 3100 kg/ha. Because in 2015 year were not sufficient rainfall (0.6 mm in the first decade of June) during the bloom-forming pods, the productions were lower, the difference from the average of two years is very significant (Table 2).

Pea yield was also differentiated by tillage systems, in the conventional tillage system achieved the highest yields of pea (Table 3). Negative significant differences in yielding obtained after applying the minimum tillage systems are to 5% and 26% in the case of no tillage system compared with the conventional tillage system.

The pea varieties Bellmondo and Camilla obtained a higher yield compared with control variant (variety average), the difference being very significant, Dora variety obtained ayield lower than the average of the four varieties, the difference being very significant (Table 4).

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

Experimental year	Yield (kg/ha)	Difference (kg/ha)
Average (control variant)	2770	-
2014	3161***	390
2015	2380^{000}	-390
LSD (p 5%) = 57; LSD (p 1%) = 105; LSD (p 0.1%) = 234		

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

Experimental year	Yield (kg/ha)	Difference (kg/ha)
Conventional tillage (control variant)	3096	-
Minimum tillage	2933^{000}	-163
No tillage	2283^{000}	-813
LSD (p 5%)= 51; LSD (p 1%)= 71; LSD (p 0.1%) = 101		

Table 4. The influence of the afila pea variety on the yield

Pea variety	Yield (kg/ha)	Difference (kg/ha)
Average (control variant)	2770	-
Tudor	2737	-33
Dora	2366^{000}	-404
Bellmondo	3074***	304
Camilla	2903***	133
LSD (p 5%) = 68; LSD (p 1%)= 91; LSD (p 0.1%) = 118		

In all three tillage systems between the number of plants/m^2 and the number of pods/m^2, number of grains/m^2 and grain weight/m^2 are direct relations (Table 5). The number of plants/m^2 has influence over the number of grains. The most important connection is between the grain number and weight of the grains, the production obtained in conventional tillage system being the results of this relationship.

Literature data show that higher yields are achieved in the no-tillage systems than in the conventional tillage systems, but in dry and semi-desert regions (Guy and Cox, 2002), in areas with loam-clay texture, the yields obtained are smaller in minimum and no tillage systems, as evidenced by our experiment, compared with the conventional tillage systems.

It is common knowledge that leguminous plants are characterized by specific traits including the dependency for high rainfall and low temperatures during flowering and forming pods. In addition, their yielding is influenced by co-effects of weather and agro-technical conditions, the variability of yielding may be high and difficult to predict (Doré et al., 1998).

Proper soil moisture conditions are a very important element that affects the germination of pea. Drought greatly limits emergence and reduces the plant density, which results in lower competitiveness against weeds (Velykis and Satkus, 2010).

The yields obtained by applying minimum tillage system shows that systems can be differentiated results, choice of tillage in relation to crop plant being determinative. The results of investigations showed that the yield is a conclusion soil tillage systems influence on soil properties, plant density assurance and on weed control (Rusu, 2005). The yield of pea was lower due to the reduced ploughing tillage as compared to the conventional ploughing (Sepp et al., 2009).

Climatic conditions have a decisive role in obtaining high yields, peas very well getting the amount of water accumulated in the soil during the winter and water from rainfall in each month of culture vegetation period (Simon et al., 2015).

Table 5. The average value of the coefficient of correlation "r" between some characteristics morpho-productive from four varieties of peas

Traits	Plants number (m^2)	Pods number (m^2)	Grains number (m^2)	Grain weight (g/m^2)	1000 grains weight (g)
Conventional tillage					
Pods number (m^2)	0.45	1			
Grains number (m^2)	0.48	0.13	1		
Grain weight(g/m^2)	0.62	0.44	0.90***	1	
1000 grains weight(g)	-0.16	0.64	-0.42	-0.18	1
Hectolitric weight	0.68	-0.05	0.79*	0.81*	-0.64
Minimum tillage					
Pods number(m^2)	0.83**	1			
Grains number (m^2)	0.71*	0.44	1		
Grain weight(g/m^2)	0.69	0.58	0.58	1	
1000 grains weight(g)	-0.43	-0.39	-0.37	-0.07	1
Hectolitric weight	0.46	0.78*	-0.20	0.58	-0.24
No tillage					
Pods number(m^2)	0.52	1			
Grains number (m^2)	0.74*	0.52	1		
Grain weight(g/m^2)	0.51	0.33	0.38	1	
1000 grains weight(g)	-0.18	-0.26	-0.60	-0.45	1
Hectolitric weight	-0.12	0.55	-0.05	-0.07	-0.32

CONCLUSIONS

The number of plants emerged, the number of pods, the number of grains and the yield was influenced by the experimental factors, the greatest influence on production elements having a tillage system and climatic conditions of the experimental years.

The climatic conditions of the two years taken into study influenced yield obtained, thus in 2014, the year favorable were obtained higher productions and in 2015, atypical year productions were obtained are lower compared to the average of the two years.

The minimum tillage stored the properties of soil, reduce the negative impact on soil, hydric regime and of natural fertility, but the yield obtained in conventional tillage system is higher than yield obtained in minimum and no tillage system.

The varieties used in the experiment have influence on production, low production achieving a variety Dora, was a very significant difference compared with the average varieties, the varieties Bellmondo and Camilla standing out by high production, difference from a control variant being very significant.

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