Optimization the Work of Soil for the Cultivation of *Afila* Peas in Turda Area

Alina ȘIMON^{1,2*}, Teodor RUSU², Felicia CHEȚAN^{1,2}, Cornel CHEȚAN^{1,2}

¹ Agricultural Research-Development Station Turda, 27 Agriculturii Street, Turda, 401100, România,

² University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, 3-5 Mănăștur Street, 400372, Cluj-Napoca, România.

*Corresponding author: *maralys84@yahoo.com*

Bulletin USAMV series Agriculture 72(2)/2015

Print ISSN 1843-5246; Electronic ISSN 1843-5386

DOI 10.15835/buasvmcn-agr: 11535

ABSTRACT

By applying minimum tillage system are reduced degradation by erosion, increase organic matter, it restores the soil structure and through the introduction of legumes in rotation ensure a higher nitrogen quantity to crops which are in rotation. Research conducted at SCDA Turda in 2014 following the behavior of four varieties of *afila* peas in two soil tillage system (classical-with mould plow and with minimum tillage-the chisel variant) and the effect of tillage on the momentary and accessible water reserve from the soil. In the minimum tillage system with chisel obtained a very significant difference of production compared to the classic system (88g/m²) at green peas, and if mature pea beans the difference of -27 kg/ha obtained in variant with chisel being insignificant. Through the application of the minimum tillage system at pea get an important economy of 28.4% in terms of fuel costs (337.2 ron/ha) compared to the classic tillage system application (471 ron/ha). For producing a 1 ton peas in classical system is necessary to 21.9 l/t fuel consumption and fuel costs of 131.6 ron/t, higher than minimum tillage system were fuel consumption are 15.8 l/t with fuel costs of 94.9 ron/t.

Keywords: *economic efficiency, peas, soil tillage systems, soil water, yield.*

INTRODUCTION

Climate change is one of the biggest economic threats social and environmental. In the context of climate change there a need to reduce consumption of energy resources, being necessary to adapt the technologies applied as to lead an effective use of available water but increasing soil water reserve (Richter *et al*, 2007).

By applying minimum tillage system aims to reduce soil erosion (Oliver and Pharr, 2004), improved soil water reserve, qualitative and quantitative production increase, economic efficiency and soil conservation (Ulrich *et al*, 2006). Cover the soil with a layer of mulch made from vegetable scraps reduce the amount of water evaporated from the soil and surface runoff

(Griffith *et al*, 1986), restores soil fertility and structure (Guş *et al*, 2004).

The tillage significantly affects the growth of crops by changing the soil structure and moisture during the period of vegetation. In generally, the changes of soil moisture due to soil tillage are related to some things: soil type, soil tillage equipment, tillage depth and climatic conditions.

Adapting to climate change requires selecting zonate varieties, the optimal time works (Rusu *et al*, 2009), plant cultivation in favorable areas and the introduction of legumes into crop. Legumes provide quality protein for humans and animals and enrich the soil with nitrogen by symbiotic fixation with genus *Rhizobium* bacteria (Singh *et al*, 2007; Șimon *et al*, 2014). Peas, one of the most

suitable legumes cultivated in regions with colder climates, to use both green and mature grains (human and animal nutrition) and secondary production as feed for animals or green fertilizer (Mihailović and Mikic, 2010; Šimon, 2015).

MATERIALS AND METHODS

The experience, a bi-factorial experience in four repetitions, was studied at ARDS Turda, in 2014, sol 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 m², with the distance between rows 18 cm, with Gaspardo Directa 400 drill. The experiment served to evaluate the yielding of pea cultivated on seeds under conditions of conventional tillage and reduced tillage.

The experimental factors: factor A: soil tillage, with 2 graduation: A1: the classical tillage system included ploughing after harvest of the previous crop in the autumn and disking in spring, A2: the minimum tillage system involved the use of a chisel after harvest of the previous crop and disking in spring; factor B: peas variety, with 4 graduation: B1: Tudor, B2: Dora, B3: Bellmondo, B4: Camilla.

Momentary reserve of soil moisture and plant accesible water reserve was determined through sampling of soil depth at 0-100 cm, using probe-type drill and drying of the samples to the steamer for a period of 8 hours at 105 °C.

Climatic conditions during the growing season of the crop of peas are presented in Fig.1 and Fig. 2. From the data presented in Fig. 1 it can be seen that the temperatures recorded in the five

months are higher than the average 57 years, the warmest month compared to the average being the month of March when temperatures have been recorded with 4,7°C higher than average monthly temperatures on the 57 years.

Values of precipitations in June are lower than the monthly average of 57 years, being considered a very dry month, and the amount of precipitations in the months of April and July is much higher than the monthly average of 57 years, being characterized as excessively rainy months. The amount of precipitations in March and May was normal compared with the average of 57 years.

RESULTS AND DISCUSSIONS

Precipitations in the winter months but those in vegetative period contributed to increasing soil moisture led to the creation of favorable conditions for emergence and development the culture of pea. The amount of precipitation in March-July period was 354.1 mm, with 57.4 mm higher than multi-annual average.

Momentary reserve of soil moisture is higher in the system with minimum tillage, on all three levels of sampling depth, the root system of the plant may benefit from a larger quantity of water compared to the classical system it can be seen in Fig. 3.

Determinations concerning momentary soil moisture, effectuated at the pea culture, on depth 0-100 cm, highlights a momentary reserve higher than the coefficient of withering, on depth 0-20 cm with 195.3 m³/ha at classical system and with 229 m³/ha at minimum tillage system, on depth 20-50 cm higher with 190.6 m³/ha at classical system and with 682.4 m³/ha at minimum tillage

Fig. 1. Thermal regime during the growing season of the pea crop, Turda 2014

Fig. 2. Pluviometric regime during the growing season of the pea crop, Turda 2014

system, on depth 50-100 cm higher with 570.6 m³/ha at classical system and with 957.2 m³/ha at minimum tillage system throughout the growing season of the crop, the plants water needs being provided from precipitation.

The field capacity was not reached in the months in which determinations were made, the values recorded in the minimum tillage system being close to field capacity than the values recorded in the classic system, the deficit compared with the field capacity being smaller.

Lowering humidity below the minimum limit (503.1 m³/ha), which inherently leads to lower production even though soil moisture reserve are greater than the coefficient of withering, was recorded only in the case of the classic system, in June and July with 10.7 m³/ha, respectively 34.4 m³/ha, on 0-20 cm depth. At the minimum tillage system not recorded humidity momentary values lower than the minimum limit (Fig. 4).

Completion of plant accessible water reserve associated with favorable temperatures have caused a normal development of pea plants in the months of spring, proven fact of pea production obtained in two soil tillage systems.

Crop yielding is a resultant of co-effects of pedo-climatic conditions and agro-technical factors the greatest importance is ascribed to tillage, plant protection and crop rotation.

Increase water reserve accessible to plants as a result of the minimum tillage system application (chisel variant) resulted an increase in the production of green peas with 88 g/m², the difference compared to the control (classical variant) are very significant (Tab. 1).

The climatic conditions in 2014, favourable year for the pea yield, made as in both system (classic and minimum tillage) the yield obtained exceed 3500 kg/ha.

The production of mature peas was lower by 27 kg/ha in case of the minimum tillage system application compared with classical system, the difference being insignificant (Tab. 2).

The productions varied depending on the variety of the crop, the Bellmondo and Camilla varieties values obtained 3844 kg/ha respectively 3788 kg/ha are higher compared with the control (Tudor variety) in the case of mature pea beans and a little lower at green pea beans production, thus indicating their suitability cultivation in two systems. To green pea beans harvest, the Dora variety had a larger production than the control but insecure statistically (Tab. 3), at mature pea beans harvest the semi-erect stem resulted in very significant production losses (Tab. 4).

For determining the economic efficiency as a result of those two soil tillage systems was made

Fig. 3. Momentary reserve of soil moisture (m³/ha)

Fig. 4. Plant accessible water reserve (m³/ha)

Tab.1. Influence of soil tillage system on the green peas/m² production

Variant	Yield (g/m ²)	Difference	Significance
Classic system	626	0	Mt.
Minimum tillage system	714	88	***
LSD (p 5%)			17
LSD (p 1%)			32
LSD (p 0.1%)			71

the reporting of all expenditure per hectare who involved these technologies.

Economic efficiency was calculated only in term of expenditure on materials and fuel, without involving other production expenses. In terms of materials cost, these were equal in the two tillage systems, realizing the economy only fuels needed for achieving culture.

The biggest expenditure made when applying the classical system are those which relate to the soil basic tillage (plowing) and representing 35.7% of the total fuel expenditure compared with the minimum tillage system where the basic tillage was done with the chisel, cost for the basic tillage being 10.1% of all expenditure with fuel.

Through the application of the minimum tillage system obtained at pea culture a significant economy of 28.4% in terms of fuel costs (337.2 lei/ha) compared to the classic system application (471 lei/ha) (Tab. 5). Taking into account the costs of materials the economy of the minimum systems application is 10.64%, that is 133.8 lei/ha (Tab. 6).

To produce 1t of peas (main production) the classical system requires a fuel consumption of 21.9 l/t and the cost of fuel at 131.6 lei/t higher than minimum tillage system where the fuel consumption is 15.8 l/t with a cost of fuel at 94.9 lei/t, reducing the fuel consumption with 28 % as a result of the minimum tillage system application.

Tab. 2. Influence of soil tillage system on the pea production

Variant	Yield (kg/ha)	Difference	Significance
Classic system	3580	0	Mt.
Minimum tillage system	3552	-27	-
LSD (p 5%)			121
LSD (p 1%)			221
LSD (p 0.1%)			490

Tab. 3. Influence of the variety on green pea/m² production

Variety	Yield (g/m ²)	Difference
Tudor	694	Mt.
Dora	699	5
Bellmondo	618	-76 ⁰⁰⁰
Camilla	669	-25 ⁰
LSD (p %)		21
LSD (p 1%)		29
LSD (p 0.1%)		39

Tab. 4. Influence of the variety on pea production

Variety	Yield (kg/ha)	Difference
Tudor	3613	Mt.
Dora	3020	-593 ⁰⁰⁰
Bellmondo	3844	231 ^{**}
Camilla	3788	175 [*]
LSD (p %)		147
LSD (p 1%)		202
LSD (p 0.1%)		275

Tab. 5. Costs made to the application of the soil tillage system

Classic system		Minimum system	
Tillage performed	Cost/ha (lei)	Tillage performed	Cost/ha (lei)
Plowing	168	Processing with chisel	34.2
Disking	34.2	Disking	34.2
Sowing	30	Sowing	30
Sprayer	9.6	Sprayer	9.6
Treatments application	19.2	Treatments application	19.2
Harvested	210	Harvested	210
Total	471	Total	337.2

Tab. 6. Costs made with materials

Material	Product	Cost/ha (lei)
Seed	Tudor, Dora, Bellmondo, Camilla (220 kg/ha)	308
Herbicides	Tender (1.5 l/ha)	120
	Pulsar (1.0 l/ha)	135
	Agil (1.0 l/ha)	85
Insecticides	Calypso (0.1 l/ha)	98
Foliar fertilizer	Agrofeed (4 l/ha)	40
Total		786

CONCLUSIONS

Momentary moisture reserve of soil and plant accessible water are greater than the minimum tillage system application plants can use the available water more efficiently.

At the minimum tillage system application haven't recorded momentary moisture values lower than the minimum limit, lowering moisture below the minimum limit was recorded only in the case of the classic system, in June and July on all 3 levels deep.

Peas cultivated in the minimum tillage system received a larger amount of water available to plants, the yield obtained as a result of harvesting green beans being higher compared with the classical tillage system.

By applying minimum tillage system era realizing an economy of 28.4% to fuel consumption, total economy obtained in the minimum tillage system with chisel application are 10.64%.

To produce 1t of peas the classical system requires a fuel consumption of 21.9 l/t higher than minimum tillage system where the fuel consumption is 15.8 l/t, reducing the fuel

consumption with 28 % as a result of the minimum tillage system application.

The efficiency of the minimum tillage systems application are confirmed only when the yield achieved made relate to all of the factors involved in getting it, in particular, the total expenditure required to implement the technology.

REFERENCES

1. Griffith DR, Mannering JV and Box JE (1986). Soil and moisture management with reduced tillage, No-tillage and surface-tillage agriculture, Wiley, New York: 19-55.
2. Guș P, Rusu T, Cernea S and Bogdan Ileana (2004). Sisteme de semănat, fertilizat și întreținere a culturilor, Editura Risoprint, Cluj Napoca.
3. Mihailović V and Mikić A (2010). Novel directions of breeding annual feed legumes in Serbia. Proceedings, XII International Symposium on Forage Crops of Republic of Serbia, Kruševac, Serbia: 81-90.
4. Oliver WC and Pharr GM (2004). Measurement of hardness and elastic modulus by instrumented indentation: Advances in understanding and refinements to methodology, J. Mater. Res., Vol. 19, No. 1: 3-20.
5. Richter GM, Lawlor DW, Latiri K, Acutis M and Qureshi K (2007). Field scale water-use efficiency inherent variability and options for crop selection and management, Workshop: how to advance the knowledge on water use

- efficiency in the Mediterranean region?, Bari, Italy: 93–100.
6. Rusu T, Guş P, Bogdan I, Moraru PI, Pop A, Clapa D, Doru IM, Oroian I, and Pop LI (2009). Implications of Minimum Tillage Systems on Sustainability of Agricultural Protection and Soil Conservation, *Journal of Food, Agriculture & Environment*, vol. 7 (2/2009): 335-338.
 7. Singh RJ, Chung GH and Nelson RL (2007). Landmark research in legumes, *Genome* 50: 525-537;
 8. Şimon A, Cheţan F, Cheţan C, Ignea M and Deac V (2014). Rezultate privind influenţa densităţii şi a fertilizării asupra producţiei la soiurile de mazăre de tip afile, *AN. I.N.C.D.A. Fundulea*, LXXXII: 227-232.
 9. Şimon Alina (2015). Mazărea-Tehnologia de cultivare în Transilvania, *Agricultura Transilvană, Buletin informativ*, 22: 55-58.
 10. Ulrich S, Hofmann B, Tischer S and Christen O (2006). Influence of Tillage on Soil Quality in a Long Term Trial in Germany, In *Soil Management for Sustainability*: 110-116.