UDC 633.71
Тутун/Tobacco, Vol.60, N^{O} 1-6, 22-26, 2010
University "St. Kliment Ohridski" - Bitola
Scientific Tobacco Institute – Prilep, R. Macedonia

ISSN 0494-3244
UDC: 633.71-631.582(497.5)
Original scientific paper

THE INFLUENCE OF SECONDARY TILLAGE ON SOIL COMPACTION AND THE YIELD OF FLUE CURED TOBACCO

Ivan Turšić[1], Milan Mesić[2], Ivica Kisić[2], Stjepan Husnjak[2]

[1]Tobacco Institute Zagreb, Svetošimunska 25, 10 000 Zagreb, Croatia. E-mail: itursic@agr.hr
[2]Faculty of Agriculture, University of Zagreb, Svetošimunska 25, 10 000 Zagreb, Croatia
itursic@agr.hr

ABSTRACT

During 2005 and 2006 a research has been carried out on the effect that application of chisel had on the flue-cured tobacco production. The research has been carried out on luvisol in the field experiment performed on the experimental field plot of Tobacco Institute of Zagreb at Pitomača. In addition to the classical tillage practices (ploughing in the autumn + soil preparation in the spring) during the spring tillage and tobacco planting preparation chisel was used. During the vegetation period, the soil was hoed up manually (I), loosened with the cultivator (II) and with chisel between tobacco rows (III). The electronic penetrometer was used for measurement of soil resistance during tobacco flowering period. The tobacco was picked six times and after the lust harvesting and flue-curing the leaf yield was determined. All data wepe processed with the statistical variance analysis. The soil resistance was lower and the tobacco yield was higher where soil was tilled with chisel as compared to the conventional soil tillage practices in the tobacco production.

Key words: tobacco, soil tillage, bulk density, tobacco yield.

ВЛИЈАНИЕ НА ДОПОЛНИТЕЛНАТА ОБРАБОТКА ВРЗ ЗБИЕНОСТА НА ПОЧВАТА И ПРИНОСОТ НА ТУТУН ОД ТИПОТ ВИРЏИНИЈА

Во текот на 2005 и 2006 година беше извршено истражување на ефектот од примената на секундарната обработка на почвата врз типот вирџинија. Истражувањето е извршено на лувисол, на експерименталните површини од Институтот за тутун - Загреб во Питомача. Покрај класичната обработка на почвата (орање во есен и подготовки на почвата во пролет), во текот на пролетната обработка и подготовките за садење на тутунот, применет е подривач. Во текот на вегетационият период, почвата беше рачно обработена (I), растресена со култиватор (II), и со подривач меѓу редовите(III). Електронски пенетрометар беше користен за мерење на почвениот отпор за време на цветањето на тутунот. Тутунот беше берен на 6 пати, а по последната берба беше утврден приносот на тутун. Сите резултати се статистички обработени со анализа на варијансата. Отпорот на збиеност на почвата беше помал, а приносот на тутунски лист повисок онаму каде што почвата беше обработена со подривач, во споредба со вообичаените мерки на почвена обработка во производството на тутун.

Клучни зборови: тутун, обработка на почвата, збиеност на почвата, принос на тутун.

INTRODUCTION

Virginia type tobacco was introduced in Croatia in the 50's for the needs of tobacco production. Initially, it was planted on sandy soils and later the production spread to heavier soils in Northern Croatia, from Đurđevac to Donji Miholjac. Economic effects and the size of farms are the main reasons why tobacco is often grown as a monoculture or in a very narrow crop rotation. Perennial tobacco growing in a monoculture on soils prone to compaction without adding organic matter led to degradation of arable layer, what was the reason of lower yield. Often shallow soil tillage on the same depth led to increased compaction in subploughing layer, especially on ploughing depth.

The major problems of tobacco soils in Croatia for current state of arable layer are of generic origin and the consequences of irregular managing of these soils. Physical characteristics of these soils are often deteriorated to the extent that water occasionally retain on the soil surface. Often emphasized compaction of plough and subplough layer makes the growth and development of the root system harder and it's the main limiting factor for achieving higher yield and better leaf quality (Turšić, I., 1994).

Yield and quality of tobacco, with the genetic potential of cultivar, significantly depend on the current soil fertility, applied agricultural practices and climatic conditions during the vegetation period (Akehurst, 1981, Hawks, Collins, 1983). Approach to managing the soil-plant system in the growing area of Virginia tobacco has to include measures such as crop rotation, calcification, appropriate fertilizer application, soil tillage, erosion, control and conservation of water in soil. Not one measure can replace the other or profitable production can be maintained until all factors which affect the productivity are well balanced.

MATERIAL AND METHODS

The influence of secondary tillage on yield of tobacco and soil compaction was investigated on experimental field in Podravina. The experiments were carried out on field trial on luvisol in four repeats according to split block method (Vasilj, 1974).

Half of experimental field (528m^2) was loosened with chisel (Table 1). On the other half disc plough was applied and then cultivator. The trial had six combinations (2×3). There were four rows of tobacco per repetition and measurements were taken on two rows in the middle.

Table 1. Trial procedures

Soil preparation for tobacco planting	Soil cultivation during the vegetation period
1. Chisel Cultivator	1.1. Manual cultivation 1.2. Cultivator 1.3. Chisel + cultivator
2. Disc plough Cultivator	2.1. Manual cultivation 2.2. Cultivator 2.3. Chisel + cultivator

The length of test field was 10m and the spacing between rows was 1.1m. The area of the main field was 44m^2. In total 528m^2 was loosened in spring (44m^2 × 3 procedures × 4 repetitions). The chisel wasn't applied on the remaining 528 m^2 but the soil was disced before the application of cultivator and tobacco planting. In the tobacco flowering (at the end of July) the soil resistance (compaction) was measured and at the same time the samples for soil moisture were taken. Soil resistance was measured by electronic penetrometer (Košutić. 1989). Current soil moisture in plough and subplough layer is determined gravimetrically.

RESULTS AND DISCUSSION

The soil on experimental field was sandy loam with high content of fine sand and dust and low content of clay, with unstable structure and tend to compaction and crust formation (Table 2).

Table 2. Mechanical composition of soil from experimental field

Soil horizon	Depth (cm)	Percentage of particles				Texture
		Coarse sand (2-0.2 µm)	Fine sand (0.2-0.02 µm)	Silt (0.02-0.002 µm)	Clay (<0.002 µm)	
A_p	0-26	15	58	17	10	sandy loam
E	26-45	18	61	15	6	sandy loam
B_i	45-90	21	36	22	21	loam

Mechanical composition and other physical properties were shown in Table 3.

Table 3. Physical properties of the soil

Soil horizon	Total porosity (%)	Field water capacity (%)	Air capacity (%)	Bulk density	
				Stv	Stp
A_p	45.6	36.4	9.2	1.46	2.70
E	38.3	33.7	4.6	1.68	2.72
B_t	41.6	34.1	7.5	1.71	2.74

Air capacity is moderately low in ploughing and iluvial horizon. Field water capacity is average in ploughing and iluvial horizon and very low in eluvial horizon. According to bulk density values soil compaction of subploughing layers is significantly higher than compaction of ploughing layer.

The application of chisel on soil of stated physical characteristics was found as fully justified. The procedure in which the chisel was applied in spring during the soil preparation, a significantly lower resistance was measured (figure 1), which resulted in significantly larger yield of tobacco leaf (Soane, Ouwerkerk, 1994, Turšić, 1992).

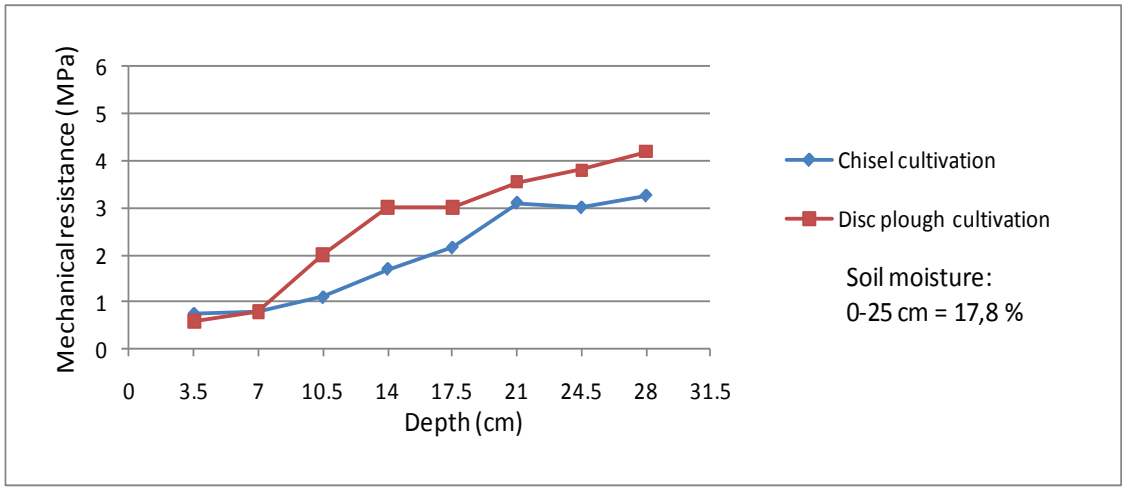

Figure 1. Influence of chisel plough tillage on soil compaction

In procedure in which the chisel was not applied a larger soil resistance was determined. Increased soil compaction conditioned by texture and the way of soil preparation reduced the growth and development of root system into the deeper layers and decreased the tobacco yield (Turšić et al. 1994).

Table 4. Influence of chisel application in soil preparation on tobacco yield, Pitomača

Soil tillage	Yield, kg/ha		$\overline{X}$
	2005	2006	
Chisel	2667,0	2733,3	2700,15
Without chisel	2336,3	2499,3	2417,00
LSD, 5%	131,2	210,1	

Lower soil resistances (lower compaction) were measured in both years of research where during the vegetation period the soil was loosened with the chisel between the rows.

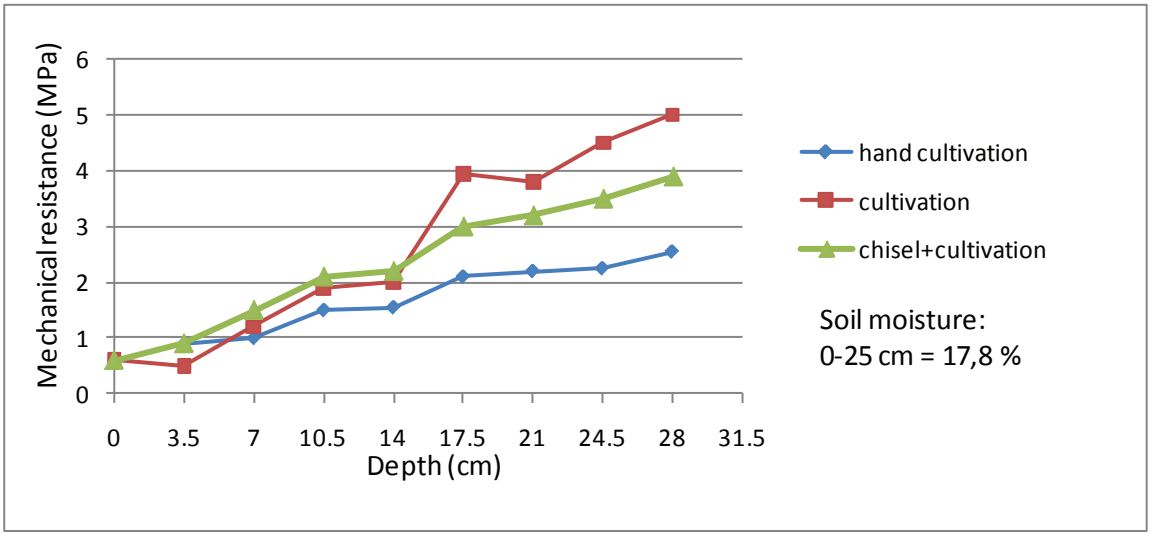

Figure 2. Influence of interrow chisel plough tillage on soil compaction

It is known that the largest part of the tobacco root system develops at depth of 30 to 40 cm (Turšić, 1989, 1994, Vepraskas et al.1986). First two weeks after transplantation tobacco develops lateral roots and that is the reason why first soil tillage between rows is conducted deeper, with the machines similar to the chisel applied in this experiment (Akehurst, 1981).

As the tobacco plants become higher and the root system develops deeper, the next cultivations are conducted shallower and their main goal is soil ventilation (crust breaking), weed removal and drainage of excess water. During the procedure in which chisel was applied between the rows, the soil was less compacted and the larger tobacco yield was obtained (Table 5).

Table 5. Influence of interrow chisel plough tillage on flue-cured tobacco yield, Pitomača 2005-2006

Interrow tillage	Yield, kg/ha		$\overline{X}$
	2005	2006	
Manual cultivation	2393,0	2649	2521
Cultivator	2422,0	2530	2476
Chisel + cultivator	2690,0	2780	2735
LSD, 5%	215,3	196,0	

Soil loosening between rows has significantly increased the tobacco yield (McKee, 1988). In average chisel application in first cultivation has increased the tobacco yield by 8,31-11,05 %.

CONCLUSIONS

The investigation of diferent types of soil preparation for tobacco cultivation has shown that chiesel application has significant advantage compared to other types of cultivation.

The application of disc plough in secondary cultivation has increased soil compaction and decreased yield of tobacco leaf so it should be avoided in soil preparation.

REFERENCES

1. Akehurst B.C., 1981. Tobacco. Second edition. Longman Inc., London, New York, 282-315.
2. Butorac J., 2009. Duhan. Zagreb.
3. Hawks S.N.JR., Collins W.K., 1983. Principles of Flue-Cured Tobacco Production. N.C. State University, Raleigh, N.C., 30-31.
4. Košutić S., 1989. Izvještaj o dinamometriranju rovila BNT. Fakultet poljoprivrednih znanosti Zagreb, 1-5.
5. McKee C.G., 1988. Effects of under row subsoiling and ridging at final cultivation on lodging of CVMD 609. Tob. Sci. 32: 7-8.
6. Soane B.D., Ouwerkerk C., 1994. Soil compaction in crop production. Elsevier, Amsterdam, London, New York, Tokyo, 365-390.
7. Turšić I., 1989. Utjecaj dubine obrade tla na prinos i kvalitetu flue-cured duhana. Arhiv za poljoprivredne nauke 50(178): 119-128.
8. Turšić I., 1992. Influence of the depth of ploughing on the soil compaction and tobacco yield in north Croatia. International Conference Soil Compaction and Soil Menagement, Tallin, Estonia, Proceedings, 243-253.
9. Turšić I., 1994. Komparativno istraživanje različitih dubina osnovne obrade tla u interakciji s mineralnom gnojidbom za duhan tipa virdžinija. Poljoprivredna znanstvena smotra 59(1): 5-20.
10. Turšić I., Čavlek M., Ćosić T., Tratnik M., Šoštarić J., Petošić D., Kovačević I., 2004. Effects of soil tillage on the yield and quality of tobacco in Croatia. Acta Agronomica Hungarica, 52(3): 221-226
11. Vasilj Đ., 1974. Postavljanje i statistička obrada pokusa po split-blok shemi. Agronomski glasnik 3/4: 125-135.
12. Vepraskas M.J., Miner G.S., 1986. Effects of subsoiling and mechanical impedance on tobacco root growth. Soil Sci A.J. 50: 423-427.