ACTA HYDROLOGICA
SLOVACA

Ročník 18, č. 1, 2017, 68 – 75

DIFFERENT SOIL TILLAGE IN RELATION TO WATER STORAGE IN PROFILE OF HEAVY SOILS

Dana Kotorová, Ladislav Kováč

The aim of this contribution was evaluation of water storage in profile of clay-loamy Gleyic Fluvisol. In field treatment between 2011 and 2016 years, the effect of conventional tillage and no-tillage technologies on maximum, average and minimum soil water storage were observed. Soil samples for the determination of water storage were taken from profile 0.0 – 0.3 m, respectively 0.0 – 0.8 m from both tillage variants. Monitoring was realised during vegetation season at two-week intervals. Obtained contents of soil water storage were re-counted at maximum soil water storage on percent of moisture of field water capacity, at average soil water storage on percent of moisture of point of decreased availability and at minimum soil water storage on percent of moisture of wilting point. Maximum, average and minimum soil water storages, in both observed depth, were significantly influenced by used tillage technology and experimental year. More significant was effect of conventional tillage than no-tillage technology. From point of view of experimental years, the most statistically significant effect had year 2014, with wet vegetation season.

KEY WORDS: soil tillage, soil water storage, heavy soils

ROZDIELNE OBRÁBANIE VO VZŤAHU K ZÁSOBE VODY V PROFILE ŤAŽKÝCH PÔD. Cieľom príspevku bolo zhodnotenie zásoby vody v profile ťažkej ílovito-hlinitej fluvizeme glejovej v rokoch 2011 – 2016. V poľnom pokuse sa sledoval vplyv konvenčnej agrotechniky spojenej s orbou a priamej sejby bez orby na maximálnu, priemernú a minimálnu zásobu vody v hĺbke profilu do 0,3 m a 0,8 m. Monitoring sa realizoval v dvojtýždňových intervaloch počas vegetačného obdobia od apríla do septembra. Zistené obsahy pôdnej vody boli prepočítané pri maximálnej zásobe na % vlhkosti poľnej vodnej kapacity, pri priemernej zásobe na % vlhkosti bodu zníženej dostupnosti a pri minimálnej zásobe na % vlhkosti bodu vädnutia. Maximálna, priemerná i minimálna zásoba pôdnej vody bola oboch sledovaných hĺbkach pôdneho profilu významne ovplyvnená obrábaním a rokom sledovania. Významnejší bol vplyv konvenčnej agrotechniky než bezorbového systému. Z pohľadu experimentálnych rokov bol najvýznamnejší vplyv roka 2014, ktorého vegetačné obdobie bolo vlhké.

KĽÚČOVÉ SLOVÁ: obrábanie pôdy, zásoba vody v pôde, ťažké pôdy

Introduce

The East Slovak Lowland is important agricultural region of Slovak Republic. For this area are typical high presence of soil with higher content of clay particles in whole profile, strong horizontal and vertical soil heterogeneity, alternation of various soil textures on short distances and specific course of weather (Vilček, 2005). The clay soil-forming process significantly impacted the formation and developing of soils in this region. Till 65 % of acreage of agricultural land on the East Slovak Lowland are heavy Gleyic Fluvisol, Mollic Gleysol, Gleyic Planosol and Gleysol (Mati et al., 2007).

The water storage in soil profile, according Demo, Bielek et al. (2000), is the only real source of water for agricultural crops and in their production process no-exist other alternative to soil water. Task of water in field crops production process during vegetation season is depended not only on its content in soil profile, but also to soil indicators and cultivated plants. Hydrolimits describe relation between plant and soil moisture (Šútor, Štekauerová, 2000; Skalová, Štekauerová, 2011). These parameters are expressed as characteristic moistures of soil, as are field water capacity (θ_{PK}-pF = 2.3), point of decreased availability (θ_{ZD}-pF = 3.3) a wilting point (θ_V-pF = 4.18). For five characteristic soil textures on the East Slovak Lowland (ESL) and individual soil horizons Šútor et al. (1995) published values of volume moisture and these correspond to hydrolimits listed above and expressed as soil moisture potential.

In last decades, the soil water storages by means of hydrolimits for soils of the East Slovak Lowland valued for example Mati and Pavelková (2007a, b), Šútor et al. (2007), Mati et al. (2008, 2011) and Kotorová et al. (2010). For years 1998 – 2005 in the East Slovak Lowland conditions, Pavelková, Mati (2008) found out positive value of average soil water storage, higher than level of point of decreased availability, only for easy sandy-loamy Eutric Fluvisol. For middle-heavy loamy Luvisol and clay loamy heavy Gleyic Fluvisol the average soil water storage was lower as is level of point of decreased availability, and so value of easy of approach water were negative.

One demonstration of exist climatic change is also increasing of the average air temperature and with it related drought. By Gomboš et al. (2006) in last years the periodicity of drought period is higher. To mitigate of drought effect on agricultural plant production, various adaptation arrangements are used, for example irrigation and suitable tillage technology for soil prepare before sowing. The protective technologies of soil may contribute for keeping of water in soil profile and so to enable the optimal course of growth and development of field crops. However, unified and obligatory criterions for drought aren't available, mainly by reason of different accesses to evaluating and reviewing of meteorological, hydrological, agricultural and bioclimatological and many other parameters. The definition of drought so isn't explicit and by Šútor et al. (2005) exist criterions formulated for drought agronomic, physiological, hydrological, meteorological, socio-economical and random.

The soil tillage is one from basic elements of technological systems for agricultural crops production on arable land. Soil cultivation may significantly to modify not only physical soil properties, but also moisture and temperature situation in soil. In soil profile 0 – 0.4 m of heavy and very heavy Gleyic Fluvisol, Ivančo et al. (1999) ascertained in very moisture vegetation season year 1998 the same level of average soil water storage under conventional tillage and no-tillage, too. In normal vegetation season 1997 and moisture vegetation season 1996 it was higher under no-tillage. The relation between actual evapotranspiration on soil water storage determined Mati et al. (2011). According to the these authors, frequency of dry periods in lowland areas of Slovakia and with related to the soil aridity is limiting factor of plant production and main field crops, too. Time development of soil water storage point to need of plant production structure solution and its optimization of soil water regime. Specification its optimization, in cause of intensive soil using, with maximum probability will be supplementary irrigation.

The effect of various soil tillage practice on water supply in soil profile studied Mati et al. (2004), Lacová, Štekauerová (2007) and Nagy et al. (2007).

Kováč et al. (2010) valuated the effect of different ways of soil tillage to moisture. They ascertained that soil protective technologies influenced of soil water balance mainly by reducing of soil compaction. Protective tillage so reduced of evapotranspiration and conserve more moisture for its using with plants in early growth-development phases ago complete stand density.

This contribution evaluate the soil water storage development in profile of clay-loamy soils of the East Slovak Lowland under conventional tillage and no-tillage.

Material and methods

The experimental site of NPPC – Agroecology Research Institute Michalovce is located at Milhostov, on the East Slovak Lowland (ESL) near of the city Trebišov with latitude 48° 40' N, longitude 21° 44' E, altitude 101 m (Fig. 1). The long-term mean yearly precipitation shows 559 mm, during vegetation season 348 mm, the mean annual temperature is 8.9 °C, during vegetation season 16.0 °C. From point of view of weather conditions evaluation, the Milhostov locality belong in climatic region T3, which is warm, very dry, lowland, continental (Linkeš et al., 1996).

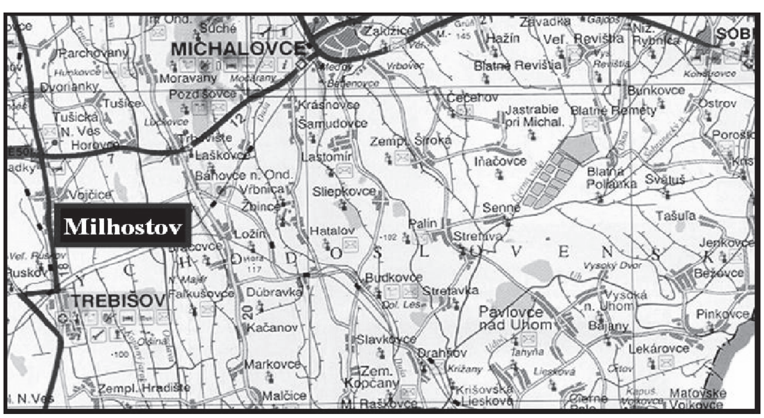

Fig. 1. Experimental site Milhostov.
Obr. 1. Experimentálne pracovisko Milhostov.

Between 2003 and 2016 in the field experiments with soil protective technologies the study of these technologies on soil water storage was realised. These treatments took place on heavy Gleyic Fluvisol and consist of four plots. Concrete observations were realized on 3rd plot. Gleyic Fluvisol in Milhostov was formed on heavy alluvial sediments by long-time impact of groundwater and surface water. The topsoil has lump aggregate structure with high binding ability and in whole profile it is heavy permeable. In depth 0.7 – 0.8 m of soil profile coherent layer of dark grey till yellow grey clay is found. Gleyic Fluvisol on 3rd experimental site by Novák classification scale (Zaujec et al., 2009) is characterized as heavy, clayey-loamy soil with content of clay particles (I. category < 0.01 mm) 54.01 %. Average granulometric composition of experimental plot is shown in Table 1.

The field crops during experimental time were arranged into crop rotation: spring barley – soybean – winter wheat – grain maize – spring barley – soybean.

In field experiment two tillage technologies of Gleyic Fluvisol – conventional tillage (CT) and direct sowing without ploughing (NT) – were examined. Conventional tillage consists of current agrotechnics operations: stubble ploughing, ploughing, smoothing, harrowing and sowing. No-tillage system use direct sowing without ploughing by sowing machine Great Plains.

Volume soil moisture, respectively water storage in soil profile was determined from disturbed soil samples taken during vegetation season, i.e. from April to September, in 2-weeks intervals in depth 0.0 – 0.8 m from each 0.1 m with three replications. Gravimetric method (Hrivnáková, Makovníková et al., 2011) was used at it.

For each layer of soil profile (0.0 – 0.8 m) the volume soil moisture (θ) was calculated by formula:

$$\theta\,[\%\ \text{obj.}] = w\,[\%\ \text{hmot.}] \times \rho_d\,[\text{kg m}^{-3}] \qquad (1)$$

where:
w – mass moisture
ρ_d – bulk density of dry soil

The effect of soil tillage methods on soil water storage in soil profile of Gleyic Fluvisol was evaluated from point of view of maximum, average and minimum water storage in soil. Maximum soil water storage (W_{max}) is the highest measured storage of soil water in concrete soil profile (0.0 – 0.3 m, or 0.0 – 0.8 m) in vegetation season regardless of date of achieving. Minimum soil water storage (W_{min}) is the lowest measured storage of soil water under the conditions as for W_{max}. The average soil water storage ($W_{\varnothing}$) is arithmetic mean of measured soil water storages from particular sampling for relevant soil profile during vegetation season of given year. Measured values of soil water storage were re-counted, according Mati et al. (2007), at maximum soil water storage on percent of moisture of field water capacity (θ_{PK}), at average soil water storage on percent of moisture of point of decreased availability (θ_{ZD}) and at minimum soil water storage on percent of moisture of wilting point (θ_V).

Obtained data was tested by statistical methods, from which regression analysis and analysis of variance were used.

Results and discussion

Production process of field crops will have optimal course only then, if soil water storage is sufficient. Irregularity of rainfall cause also the time changes of soil water storage. Differences in this water storage have impact on agricultural crops and its yields. Soil protective technologies are contribution to improvement of soil environment quality a better soil management with water. Sum of precipitation for individual vegetation season of experimental years are listed in Table 2.

For Meteorological station Milhostov the long-term normal of rainfall during vegetation season is 348 mm (Mikulová et al., 2008). The observed years reached long-time rainfall normal from 65.2 % to 122.1 %. From point of view of sum of precipitation, the vegetation season were as follows: dry – 2015 year; normal – 2011, 2012, 2013 and 2016 years; wet – 2014 year. Detailed evaluation of atmospheric precipitation for the East Slovak Lowland published Čepčeková and Hlavatá (2011).

Results obtained from monitoring in experimental years on the East Slovak Lowland give information about water in soil for rainfall different years. The maximum soil water storage, as percent of moisture of field water capacity, are in Table 3.

Table 1. Average granulometric composition of 3rd experimental plot
Tabuľka 1. Priemerné zrnitostné zloženie pre 3. pokusnú parcelu

Diameter of particles [mm]	Characteristics of particles	[%]
< 0.001	clay	27.45
0.001 – 0.01	fine and medium dust	26.55
0.01 – 0.05	coarse dust	31.99
0.05 – 0.25	fine sand	12.73
0.25 – 2.00	medium sand	1.27
< 0.01	I. category – clay particles	54.01
Soil texture		clay-loamy soil

Table 2. The rainfall [mm] in experimental years for Milhostov
Tabuľka 2. Sumy zrážok [mm] v experimentálnych rokoch v Milhostove

Month	DN	2011	2012	2013	2014	2015	2016	$\bar{x}$ Y
IV.	41	14	33	41	46	6	13	26
V.	57	46	32	82	76	53	66	59
VI.	70	112	60	78	23	49	36	60
VII.	74	166	119	34	154	35	100	101
VIII.	62	11	10	14	96	2	89	37
IX.	44	41	53	49	30	82	46	50
∑ IV. – IX.	348	390	307	298	425	227	350	333

Where: DN – long-term normal from years 1961 – 1990, $\bar{x}$ Y – yearly average

Table 3. The maximum soil water storage [% θ_{PK}]
Tabuľka 3. Maximálna zásoba pôdnej vody [% θ_{PK}]

Year	Depth of soil profile					
	0.0 – 0.3 m			0.0 – 0.8 m		
	CT	NT	$\bar{x}$	CT	NT	$\bar{x}$
2011	104.09	109.90	107.00	105.89	107.78	106.84
2012	106.31	97.78	102.05	104.62	98.99	101.81
2013	94.72	84.78	89.75	86.55	81.85	84.20
2014	101.16	91.76	96.46	101.88	95.33	98.61
2015	77.35	77.12	77.24	83.19	75.40	79.30
2016	95.22	92.33	93.78	95.07	88.00	91.54
$\bar{x}$ Y	96.48	92.28	94.38	96.20	91.23	93.71

Where: CT – conventional tillage, NT – no-tillage, θ_{PK} – moisture of field water capacity

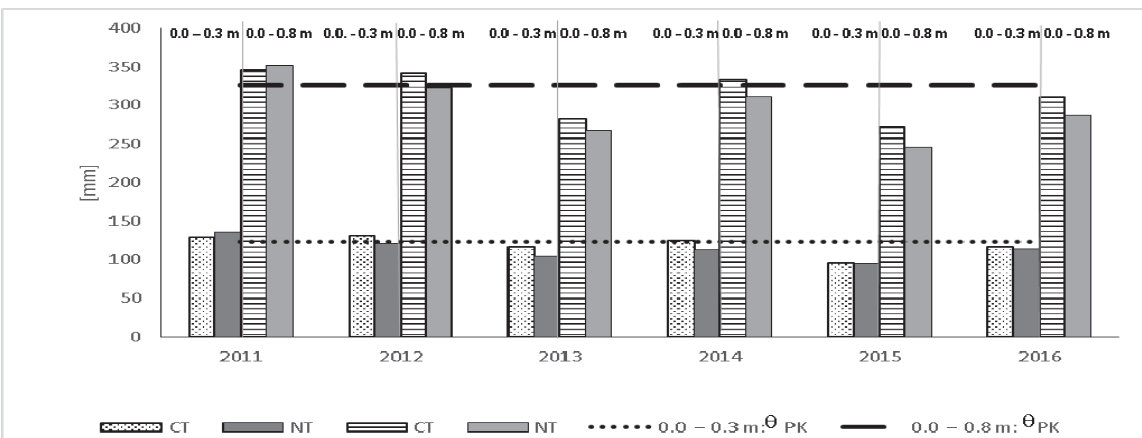

Fig. 2. The maximum water storage in Milhostov.
Obr. 2. Maximálna zásoba vody v Milhostove.

In soil profile 0.0 – 0.3 m the values of maximum soil water storage reached 77.35 – 106.31 % of moisture of field water capacity under conventional tillage and for no-tillage variant it was 77.12 – 109.90 %. Maximum soil water storage was higher (in average about 4.20 %) for variant with conventional tillage in comparison with no-tillage variant. Similar dependences were ascertained also for maximum soil water storage in profile 0.0 – 0.8 m. The values achieved 83.19 – 105.89 % of moisture of field water capacity for CT variant and 75.40 – 107.78 % for no-tillage variant. For soil profile 0.0 – 0.8 m differences between tillage variants were larger. The similar results on heavy Gleyic Fluvisol find out also Mati et al. (2007), Kotorová et al. (2010) and Šútor et al. (2007).

The moisture of field water capacity for profile 0.0 – 0.3 m is 123.22 mm and for profile 0.0 – 0.8 m it is 326.30 mm (Šútor et al., 1995). On figure 2 the course of maximum soil water storage in both soil profile is shown. In individual experimental year this value is various. Determined maximum soil water storage corresponded with rainfall in concrete year.

Maximum soil water storage was significantly influenced by used tillage technology, experimental year and sampling depth. More significant was effect of conventional tillage and years 2012 and 2014 (Table 6. and 7.).

The average soil water storage for whole vegetation season of experimental years, expressed as percent of moisture of point of decreased availability are listed in Table 4. In both observed depth of soil profile, in all the average soil water storage was higher under conventional tillage in comparison with no-tillage variant. Graphic presentation of average soil water storage is on Fig. 3.

Average soil water storage in monitoring period reached 78.67 – 110.54 % of moisture of point of decreased availability. The effect of tillage and year was statistically significant. For both soil profile, the effect of year on average soil water storage was statistically significant and years 2011 and 2012 were most significant.

The minimum soil water storage (Table 5.) for both tillage variant in both soil profile was in all higher as wilting point moisture and achieved 103.61 %, or 110.19 % of this moisture. For both tillage variants, the minimum soil water storage in depth 0.0 – 0.3 m decreased under moisture of wilting point in years 2012, 2015 and 2016. In depth 0.0 – 0.8 m, the minimum soil water storage was lower in years 2012 and 2016 on CT variant, on NT variant it was in years 2012, 2015 and 2016. The similar results published Mati et al. (2007), Liu et al. (2013), Zhang et al. (2016).

On Figure 4. are shown minimum soil water storages in comparison with moisture of wilting point. This is 71.22 mm for depth 0.0 – 0.3 m and 188.49 mm for depth 0.0 – 0.8 m.

From Table 6. and Table 7. it becomes clear statistically significant effect of tillage technology and year on minimum soil water capacity for both soil profile. Similarly, as at maximum and average soil water storage, more significant was conventional tillage with ploughing. The most significant was year 2014, when its vegetation season was wet (425 mm rainfall, i.e. 122.1 % of long-time average).

Table 4. The average soil water storage [% θ_{ZD}]
Tabuľka 4. Priemerná zásoba pôdnej vody [% θ_{ZD}]

Year	Depth of soil profile					
	0.0 – 0.3 m			0.0 – 0.8 m		
	CT	NT	$\bar{x}$	CT	NT	$\bar{x}$
2011	101.81	102.81	102.31	102.26	101.11	101.69
2012	100.96	100.09	100.53	102.04	99.03	100.54
2013	93.31	88.34	90.83	94.24	92.53	93.39
2014	110.54	102.95	106.75	110.06	105.06	107.56
2015	83.32	76.29	79.81	86.25	78.67	82.46
2016	87.22	86.18	86.70	91.46	88.75	90.11
$\bar{x}$ Y	96.19	92.78	94.49	97.72	94.19	95.96

Where: CT – conventional tillage, NT – no-tillage, θ_{ZD} – moisture of point of decreased water availability

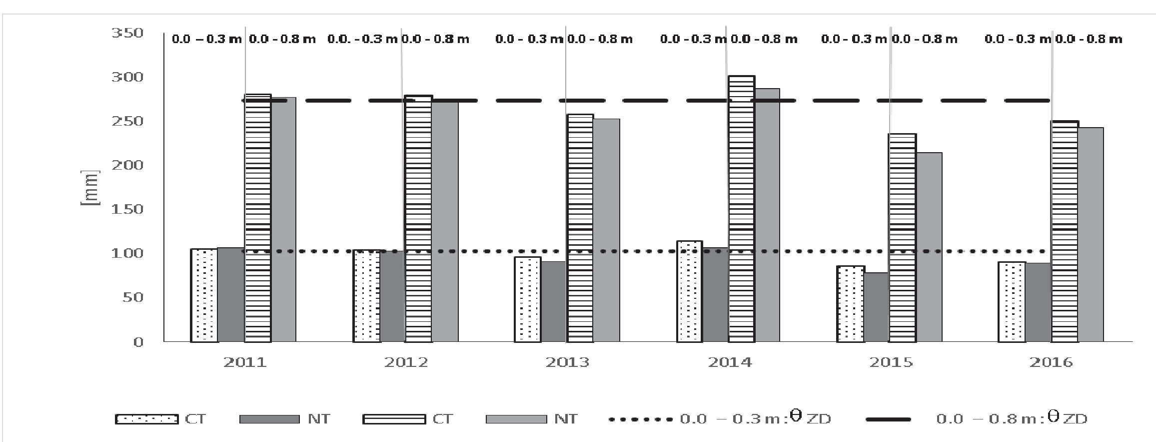

Fig. 3. The average water storage in Milhostov.
Obr. 3. Priemerná zásoba vody v Milhostove.

Table 5. The minimum soil water storage [% θ_V]
Tabuľka 5. Minimálna zásoba pôdnej vody [% θ_V]

Year	Depth of soil profile					
	0.0 – 0.3 m			0.0 – 0.8 m		
	CT	NT	$\bar{x}$	CT	NT	$\bar{x}$
2011	115.05	119.21	117.13	120.93	119.39	120.16
2012	83.88	89.61	86.75	93.93	94.28	94.11
2013	117.64	109.58	113.61	129.18	118.23	123.71
2014	135.76	125.95	130.86	137.93	125.50	131.72
2015	91.81	83.49	87.65	102.09	92.63	97.36
2016	81.47	89.83	85.65	93.67	94.50	94.09
$\bar{x}$ Y	104.27	102.95	103.61	112.96	107.42	110.19

Where: CT – conventional tillage, NT – no-tillage, θ_V – moisture of wilting point

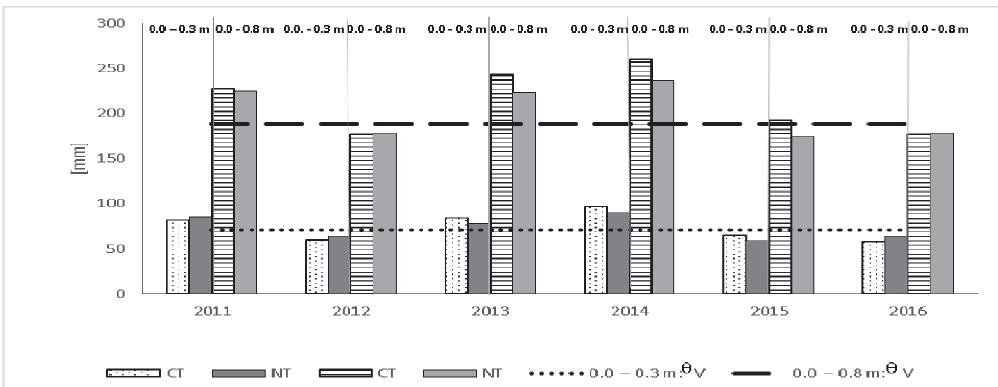

Fig. 4. The minimum water storage in Milhostov.
Obr. 4. Minimálna zásoba vody v Milhostove.

Table 6. Analysis of variance for observed soil water storage parameters
Tabuľka 6. Analýza variancie sledovaných parametrov zásoby pôdnej vody

Source of variability	Degree of freedom	W_{max}		$W_{\varnothing}$		W_{min}	
		F	P	F	P	F	P
tillage	1	18.06	++	22.96	++	7.41	++
year	5	58.26	++	76.73	++	79.25	++
depth	1	5657.15	++	10955.57	++	4105.25	++
residual	85						
total	95						

$^{++}P< 0.01$ $^{+}P< 0.05$

Where: W_{max} – maximum soil water storage, $W_{\varnothing}$ – mean soil water storage, W_{min} – minimum soil water storage, F – observed value, P – probability

Table 7. Statistical evaluation of observed soil water storage parameters values (α = 0.05)
Tabuľka 7. Štatistické hodnotenie hodnôt vybraných parametrov zásoby pôdnej vody (α = 0,05)

Source of variability	Factor	Observed parameter		
		W_{max} [mm]	$W_{\varnothing}$ [mm]	W_{min} [mm]
Soil tillage	CT	216.39 b	184.44 b	143.59 b
	NT	206.69 a	176.88 a	137.90 a
Year	2011	240.26 e	192.06 d	154.96 b
	2012	228.96 d	189.57 d	119.58 a
	2013	192.67 b	174.77 c	157.04 b
	2014	220.31 d	202.41 e	170.73 c
	2015	176.95 a	157.02 a	122.97 a
	2016	207.12 c	168.14 b	119.17 a
Depth	0.0 – 0.3 m	116.29 a	98.09 a	73.79 a
	0.0 – 0.8 m	305.79 b	263.24 b	207.69 b

Where: W_{max} – maximum soil water storage, $W_{\varnothing}$ – mean soil water storage, W_{min} – minimum soil water storage, CT – conventional tillage, NT – no-tillage, ascenders (a, b, c, d, e, f) between factors suggestive of statistically significant references (α = 0.05) – LSD test

Conclusion

In observed time, the analysis of variance confirmed statistically significant effect of used soil tillage systems on maximum, average and minimum soil water storage in both soil profiles. The effect of conventional tillage was more significant than no-tillage technology.

Effect of experimental year was also statistically significant. The most significant effect had year 2014 with the sum of precipitation 425 mm and with wet vegetation season.

For the whole experimental period the maximum soil water storage was higher under conventional tillage about 4.20 % of moisture of field water capacity for depth 0.0 – 0.3 m and about 4.97 % for depth 0.0 – 0.8 m in comparison with no-tillage. Similarly it was for average and minimum soil water storage.

Acknowledgement

This work was supported by the Slovak Research and Development Agency under the contract No. APVV-15-0489 and APVV-0163-11.

Literature

Demo, M., Bielek, P. et al. (2000): Regulačné technológie v produkčnom procese poľnohospodárskych plodín. Nitra: SPU, Bratislava: VÚPOP, 667 s. ISBN 80-7137-732-5

Čepčeková, E., Hlavatá, H. (2011): Výskyt extrémnych atmosférických zrážok na Východoslovenskej nížine v roku 2010. In: Vplyv antropogénnej činnosti na vodný režim nížinného územia. Michalovce: ÚH SAV VHZ, 2011, 61 – 68. ISBN 978-80-89139-23-1

Gomboš, M., Šútor, J., Tall, A., Burger, F. (2006): Odhad klimatického ukazovateľa zavlaženia na Východoslovenskej nížine z klimatických scenárov. In: Acta Hydrologica Slovaca, roč. 7, č. 2, 2006, 153 – 162.

Hrivňáková, K., Makovníková, J. et al. (2011): Jednotné pracovné postupy rozborov pôd. 1. vyd. Bratislava : VÚPOP. 2011, 136 s. ISBN 978-80-89128-89-1.

Ivančo, J., Pavelková, D., Gomboš, M., Mati, R. (1999): Vplyv agrotechniky na vlhkostný režim fluvizemí glejových v Milhostove. In: Zborník vedeckých prác OVÚA Michalovce. 15, 1999, 133 – 143.

Kotorová, D., Šoltysová, B., Mati, R. (2010): Vlastnosti fluvizemí na Východoslovenskej nížine pri ich rozdielnom obrábaní. 1. vyd. Michalovce: CVRV – Výskumný ústav agroekológie, 2010. 160 s. ISBN 978-80-89417-25-4.

Kováč, K. et al. (2010): Minimalizačné a pôdoochranné technológie. Nitra: Agroinštitút, š. p., 2010, 142 s. ISBN 978-80-7139-139-5

Lacová, E., Štekauerová, V. (2007): Soil water dynamics of the hillside. Cereal Research Communications, **35:** 2. 705 – 706.

Linkeš, V., Pestún, V., Džatko, M. (1996): Príručka pre používanie máp bonitovaných pôdno-ekologických jednotiek. 3. vyd. Bratislava : VÚPÚ, 1996. 103 s. ISBN 80-85361-19-1

Liu, S., Zhang, X., Yang, J., Drury, C. F. (2013): Effect of conservation and conventional tillage on soil water storage, water use efficiency and productivity of corn and soybean in Northern China. In: Acta Agriculturae Scandinavica, Section B – Soil & Plant Science, vol. 63, no. 5, 383 – 394. DOI: 10.1080/09064710.2012.762803

Mati, R., Kotorová, D. (2007): The effect of soil tillage system on soil bulk density and other physical and hydrophysical characteristics of Gleyic Fluvisol. Journal of Hydrology and Hydromechanics, **55:** 4. 246 – 252.

Mati, R., Gomboš, M., Pavelková, D., Ivančo, J. (2004): The effect of no-tillage system on soil water content of heavy soils of the East-Slovakian Lowland. Journal of Hydrology and Hydromechanics, **52:** 2. 134 – 138.

Mati, R., Pavelková, D. (2007a): Vlhkostný režim fluizeme kultizemnej na Východoslovenskej nížine. In: Zborník vedeckých prác SCPV – ÚAe Michalovce. Michalovce : SCPV – ÚAe, 23, 2007, s. 361 – 372. ISBN 978-80-99972-70-2

Mati, R., Pavelková, D. (2007b): Vyhodnotenie vlhkostného režimu fluvizeme glejovej v rokoch 1999 – 2005. In: Bioclimatology and natural hazards, Bratislava: SBS, 2007. CD ROM (nestr.). ISBN 978-80-228-1760-8

Mati, R., Pavelková, D., Ivančo, J. (2007): Zásoba pôdnej vody v ťažkých pôdach Východoslovenskej nížiny pri ich rozdielnom obrábaní. In: Acta hydrologica Slovaca, vol. 8, 2007, n. 2, 210 – 216.

Mati, R., Pavelková, D., Ivančo, J. (2008): Vlhkostný režim fluvizeme glejovej na Východoslovenskej nížine. In: Acta hydrologica Slovaca, vol. 9, n. 1, 115 – 122

Mati, R., Kotorová, D., Gomboš, M., Kandra, B. (2011): Development of evapotranspiration and water supply of clay-loamy soil on the East Slovak Lowland. In: Agricultural Water Management, vol. 98, 2011, no. 7, 1133 – 1140. DOI: 10.1016/j.agwat.2011.02.007

Mikulová, K. et al. (2008): Klimatologické normály 1961 – 1990 meteorologických prvkov teplota vzduchu a atmosférické zrážky : Záverečná správa výskumnej úlohy. Bratislava : SHMÚ, 2008. CD

Nagy, V., Šterauerová, V., Neményi, M., Milics, G., Koltai, G. (2007): The role of soil moisture regime in sustainable agriculture in both side of river Danube in 2002 and 2003. Cereal Research Communications, **35:** 2, 821 – 824.

Pavelková, D., Mati, R. (2008): Kvantifikácia množstva prístupnej vody pre rastlinný kryt z hľadiska pôdneho druhu. In: Transport vody, chemikálií a energie v systéme pôda – rastlina – atmosféra. Bratislava : ÚH SAV, 2008, 411 – 418. ISBN 978-80-89139-16-3

Skalová, J., Štekauerová, V. (2011): Pedotransferové funkcie a ich aplikácia pri modelovaní vodného režimu pôdy. 1. vyd. Bratislava : Slovenská technická univerzita Bratislava, 2011. 101 s. ISBN 978-80-227-3431-8.

Šútor, J., Gomboš, M., Mati, R., Tall, A., Ivančo, J. (2007): Voda v zóne aerácie pôd Východoslovenskej nížiny. Bratislava : ÚH SAV, Michalovce: SCPV – ÚAe, 2007, 280 s. ISBN 80-89139-10-8.

Šútor, J., Mati, R., Ivančo, J., Gomboš, M., Kupčo, M., Šťastný, P. (1995): Hydrológia Východoslovenskej nížiny. Michalovce : Media Group, 1995, 467 s. ISBN 80-88835-00-3

Šútor, J., Štekauerová, V. (2000): Hydrofyzikálne charakteristiky pôd Žitného ostrova. Bratislava: ÚH SAV, 2000. 166 s. ISBN 80-968480-1-1

Vilček, J. (2005): Pedogeografické špecifiká pôd Východoslovenskej nížiny. In: Realizáciou poznatkov vedy a výskumu k trvalo udržateľnému poľnohospodárstvu, Michalovce: VÚRV – ÚA, 2005, 93 – 97. ISBN 80-88790-40-9

Zaujec, A., Chlpík, J., Tobiášová, E. (2009): Pedológia a základy geológie. 1. vyd. Nitra: Slovenská poľnohospodárska univerzita v Nitre, 2009. 400 s. ISBN 978-80-552-0207-5

OBRÁBANIE PÔDY VO VZŤAHU K ZÁSOBE VODY V PROFILE ŤAŽKÝCH PÔD

V rokoch 2011 – 2016 sa v poľnom stacionárnom pokuse v Milhostove, na experimentálnom pracovisku NPPC – Výskumného ústavu agroekológie Michalovce, realizoval výskum vplyvu rozdielneho obrábania pôdy na zásobu vody v profile ťažkej ílovito-hlinitej fluvizeme glejovej. Fluvizem glejová v Milhostove má v celom profile priemerný obsah ílovitých častíc 54,01 %. Ornica sa vyznačuje hrudkovitou štruktúrou s vysokou pútacou schopnosťou. Je ťažko priepustná v celom profile. V pôdnom profile v hĺbke 0,7 – 0,8 m sa nachádza tmavosivý až žltosivý íl. Odber pôdnych vzoriek pre zistenie zmien v obsahu pôdnej vody bol realizovaný vo vegetačnom období v približne dvojtýždňových intervaloch do hĺbky 0,8 m vo vrstvách 0,1 m v troch opakovaniach. Vzorky sa odoberali z dvoch variantov obrábania, a to z variantu s konvenčnou agrotechnikou (CT), ktorá je spojená s tradičnou orbou a z variantu bez orby (NT), kedy sa pôda pred sejbou plodiny neorie a seje sa priamo do neobrobenej pôdy.

Vlhkosť pôdy sa stanovovala gravimetrickou metódou. Objemová vlhkosť pôdy sa stanovila vynásobením hmotnostnej vlhkosti objemovou hmotnosťou suchej pôdy zistenou pre príslušné vrstvy pôdneho profilu (0,0 – 0,8 m). Vplyv použitých spôsobov obrábania pôdy na zásobu vody v pôdnom profile sa hodnotil z pohľadu maximálnej, priemernej a minimálnej zásoby vody v pôde. Maximálna zásoba pôdnej vody predstavuje najvyššiu nameranú zásobu pôdnej vody v konkrétnom pôdnom profile (0,0 – 0,3 m, resp. 0,0 – 0,8 m) vo vegetačnom období daného roku bez ohľadu na termín, kedy bola dosiahnutá. Minimálna zásoba pôdnej vody predstavuje naopak najnižšiu nameranú zásobu pôdnej vody za vyššie uvedených podmienok. Priemerná zásoba pôdnej vody je aritmetickým priemerom nameraných zásob pôdnej vody z jednotlivých odberov pre príslušný pôdny profil v priebehu vegetačného obdobia daného roku. Namerané hodnoty zásoby pôdnej vody boli prepočítané pri maximálnej zásobe pôdnej vody na percentá vlhkosti poľnej vodnej kapacity, pri priemernej zásobe pôdnej vody na percentá vlhkosti bodu zníženej dostupnosti a pri minimálnej zásobe pôdnej vody na percentá vlhkosti bodu vädnutia. Získané výsledky boli spracované matematicko-štatistickými metódami.

Pri konvenčnom obrábaní hodnoty maximálnej zásoby vody v profile 0,0 – 0,3 m v intervale 95,31 – 130,99 mm dosahovali 77,35 – 106,31 % vlhkosti poľnej vodnej kapacity. Pri bezorbovej agrotechnike zásoba pôdnej vody 95,02 – 135,42 mm zodpovedala 77,12 – 109,90 % vlhkosti θ_{PK}. V profile do 0,8 m vyššie hodnoty maximálnej zásoby vody (v priemere o16,24 mm) boli pri konvenčnej agrotechnike. Priemerná zásoba vody v profile ornice dosahovala 78,94 – 114,39 mm, čo bolo na úrovni 76,29 – 110,54 % vlhkosti bodu zníženej dostupnosti. V profile 0,0 – 0,8 m hodnoty tohto parametra sa nachádzali v rozpätí 215,29 – 301,18 mm, čo zodpovedalo 78,67 – 110,06 % vlhkosti θ_{ZD}. V oboch profiloch bola vyššia priemerná zásoba pôdnej vody pri konvenčnej agrotechnike v porovnaní s priamou sejbou bez orby. Podobné to bolo aj pri minimálnej zásobe vody v pôde. V profile 0,0 – 0,3 m sa jej hodnoty dosahovali 81,47 – 135,76 % vlhkosti bodu vädnutia, v profile 0,0 – 0,8 m to bolo 92,63 – 137,93% vlhkosti θ_V. Vyššie hodnoty (o 1,32 % vlhkosti θ_V pre profil 0,0 – 0,3 m, resp. o 5,54 % θ_V pre profil 0,0 – 0,8 m) boli pri konvenčnej agrotechnike.

Získané výsledky boli podrobené štatistickému testovaniu, s využitím analýzy variancie. Maximálna, priemerná i minimálna zásoba pôdnej vody bola oboch sledovaných hĺbkach pôdneho profilu významne ovplyvnená obrábaním a rokom sledovania. Na zásobu vody v oboch pôdnych profiloch významnejšie vplývala konvenčná agrotechnika než bezorbový systém. Z pohľadu experimentálnych rokov bol najvýznamnejší vplyv roka 2014, ktorého vegetačné obdobie bolo vlhké.

RNDr. Dana Kotorová, PhD.
Ing. Ladislav Kováč, PhD.
NPPC – Agroecology Research Institute Michalovce
Špitálska 1273,
071 01 Michalovce
Slovak Republic
Tel.: +421 56 6443 888
E-mail: kotorova@minet.sk
kovac@minet.sk