BULGARIAN ACADEMY OF SCIENCES
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BIG BALANCE-LYSIMETERS NEEDED FOR SIMULATION OF BILATERALLY ACTING DRAINAGE SYSTEMS ГОЛЕМИ БАЛАНСОВИ ТЕГЛОВНИ ЛИЗИМЕТРИ ЗА СИМУЛИРАНЕ НА ВИЛАТЕРАЛНО ДЕЙСТВИЕ НА ДРЕНАЖНИ СИСТЕМИ

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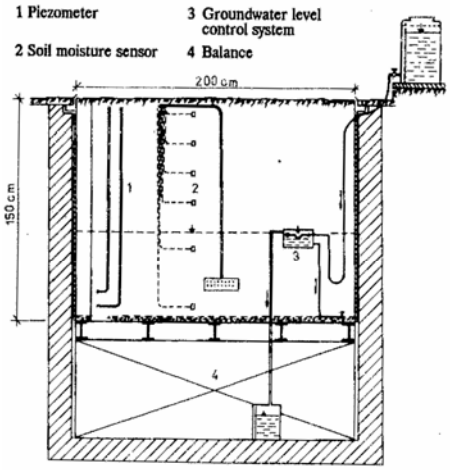


Fig. 1 Layout of a large lysimeter. 1 – Piezometer; 2 – moisture sensor; 3 – groundwater level control system; 4 – balance.

The hydrogeological conditions in many riverside polders give possibilities for building of bilateral drainage-irrigation systems with a good economic effect.

A lysimeter station in the Karaboaz polder (40 000 hectares) , near to the Danube River was built and equipped in 1980. Soil blocks from four soil types of polders were fitted in water-tight containers, laid, over 12-ton balances with high precision and installed in appropriate shafts

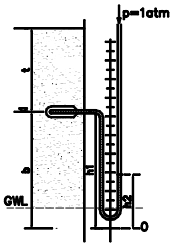
Observations and measurements *The water balance calculations for the lysimeter blocks for a certain time period are made according to the equitation*

$$Wo+P+K+M+D-E-O-F=Wend$$

where the symbols designate:
Wo *and* ***Wend*** *- the weights of the lysimeter blocks in the beginning and in the end of the measurement period;* ***P*** *– the precipitation;* ***K*** *– the condense water, determined as a difference between the increased weight of the lysimeter and the measured precipitation (-);* ***M*** *- the irrigation water;* ***E*** *– the evapotranspiration (+);* ***D*** *– the water coming from a "drainage" for maintaining the ground water level;* ***O*** *- surface water overflowing trough the lysimeter board and* ***F*** *percolation water to the ground water level.*

As a result of calculation, the evapotranspiration ***E (+)*** *or the condense water* ***K (-)*** *values can be obtained. We can receive correctly the value* ***(E –K)*** *and we can asses the influence of both factors for the measured time period.*

Soil profiles of the lysimeters 1, 2, 3 and 4



Soil moisture sensor

Soil blocks sizes:
depth -1,5 m
Horizontal:
two blocks 1,5 X 2,0 m2;
two blocks 2,0 X 2,0 m2
Max. measuring ability - 12 000 kg;
accuracy – 1kg

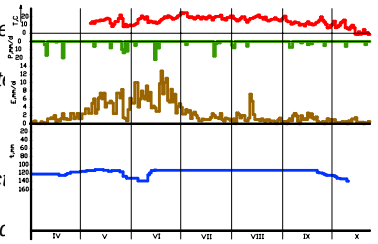
Soil types:
1. *sand +clay;*
2. *sandy soil*
3. *salt soil*
4. *heavy march soil*

Building of the soil blocks –single soil undisturbed cubes – 0,4 x 0,4 x 04 m³, cling close one to other

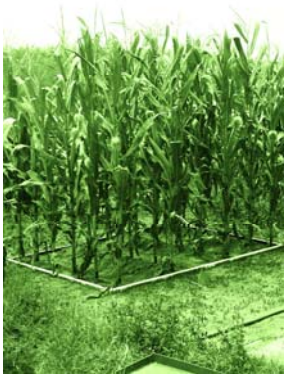
During the first three years after the constructing of the lysimeters the soil surface was sown with Lucerne. During the next 6 ears the following plants were on the lysimet surface and on the neighboring territory cultivated: maize, sunflower, sugar beet, fodder beet, oats and tomato.
All agro technical manipulations were respect in connection with the growth of the plants. They were marked the special cases require ground water surface control

Concerning the Lucerne, after every swath the fresh weight was measured Connected with the development of the young Lucerne they was marked sensitive differences in the yield in the first and in the next one or three years. The yields from the other cultures were measured at the end of their ripeness.

The irrigation, a regularly and needed practice for that region by the lysimetrical observations was changed with the controlling of the ground water level and by following of the soil moisture.



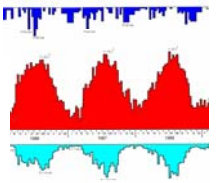
Kinetics of observed daily values for Lysimeter No 1, 1990.



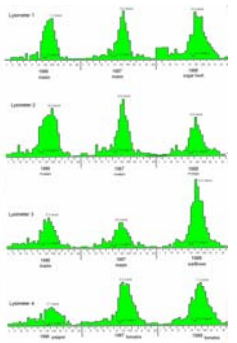
Maize

Preparation of the soil blocks in the containers

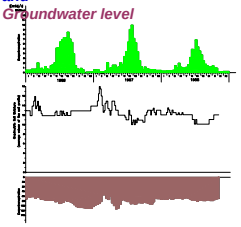
Ten days time series value for the precipitations, atmosphere temperature and the deficit of the water vapor pressure



Evapotranspiration



Evapotranspiration, Soil moisture and Groundwater level



The hydro-meteorological data were observed in situ. It could be shown a very clear dependence between the hydro-meteorological data and the evapotranspiration rate for the different cultures

Water balance in the aeration zone of lysimeter No 1 during the period of vegetation [mm]

Year	Plant	Income/outlay on the soil surface				Income/outlay on the ground water level		Change of water storage	Evapotranspiration		Yield kg
		P	K	M	O	D	F	$W_{end}-W_o$	E	e, mm/d	
1983	lucerne	294	30	112	–	–	–	– 29	465	2,1	3,67
1984	lucerne	373	18	–	7	459	95	– 238	986	4,6	12,6
1985	maize	137	20	16	–	801	–	– 179	795	3,7	1,39
1986	maize	286	15	9	–	357	65	11	591	2,8	1,16
1987	maize	262	10	–	2	407	124	– 4	557	4,5	1,03
1988	sugar beet	201	1	–	–	514	10	11	695	4,6	4,73
1989	oats	114	-	–	–	245	–	49	408	4	0,62
1990	fodder beet	165	2	–	–	460	13	71	685	4	11,6

Water balance in the aeration zone of lysimeter No 2 during the period of vegetation [mm]

Year	Plant	Income/outlay on the soil surface				Income/outlay on the ground water level		Change of water storage	Evapotranspiration		Yield kg
		P	K	M	O	D	F	$W_{end}-W_o$	E	e, mm/d	
1983	lucerne	294	47	186	-	-	-	-132	509	2,5	3,33
1984	lucerne	373	10	-	13	518	68	-319	1161	4,7	14,6
1985	maize	137	5	12	-	775	-	-148	793	2,9	1,60
1986	maize	286	8	8	3	435	6	-4	770	3,6	2,02
1987	maize	262	24	-	1	485	150	54	674	5,5	1,45
1988	maize	201	4	-	-	306	15	3	493	4,0	0,63
1989	sunflower	147	3	-	-	583	3	124	850	6,4	0,10
1990	oats	154	2	-	-	381	-	62	599	4,2	0,25

Water balance in the aeration zone of lysimeter No 3 during the period of vegetation [mm]

Year	Plant	Income/outlay on the soil surface				Income/outlay on the ground water level		Change of water storage	Evapotranspiration		Yield kg
		P	K	M	O	D	F	$W_{end}-W_o$	E	e, mm/d	
1983	lucerne	294	33	250	-	-	-	-118	695	3,2	0,75
1984	lucerne	373	15	-	6	375	7,5	-199	880	4,1	13,2
1985	maize	137	7	177	-	93	-	24	438	2,0	0,08
1986	maize	286	3	15	0	103	6	-32	433	2,0	0,86
1987	maize	262	9	30	2	111	61	-63	412	3,3	0,40
1988	sunflower	201	3	-	-	601	5	-57	857	7,1	0,19
1989	sunflower	147	-	-	-	407	-	98	652	4,9	0,38
1990	sunflower	154	8	-	-	507	-	101	767	4,4	0,43

Water balance in the aeration zone of lysimeter No 4 during the period of vegetation [mm]

Year	Plant	Income/outlay on the soil surface				Income/outlay on the ground water level		Change of water story	Evapotranspiration		Yield kg
		P	K	M	O	D	F	$W_{end}-W_o$	E	e, mm/d	
1983	lucerne	294	47	186	-	-	-	13	540	2,5	4,0
1984	lucerne	373	10	-	12	518	108	-216	1002	4,7	15,7
1985	maize	137	5	12	-	412	-	-50	616	2,9	1,06
1986	pepper	286	2	20	0	179	56	8	423	2,0	-
1987	tomatos	262	5	2	2	478	69	-52	728	4,1	13,5
1988	tomatos	201	1	2	-	513	11	-29	735	4,6	8,22
1989	tomatos	138	9	-	-	203	1	135	4	3,2	5,5
1990	oats	154	-	-	-	126	-	136	416	3,4	0,26

Conclusions

The "balance lysimeter" structure is the only one allowing to receive directly and continuously all data needed for the assessment of the kinetics and the values of the water balance elements in a soil medium
And The conditions in the "big lysimeters" could be made completely close to the natural field conditions. From that point of view the received results under conditions of controlled groundwater level have practical sense.