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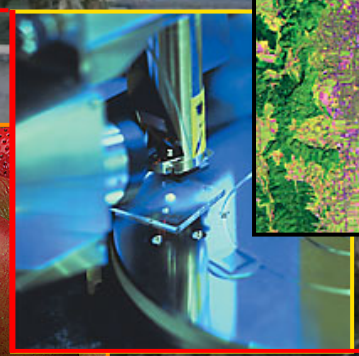

Partner of Economy

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INNOVATION aus TRADITION

ISO 9001 zertifiziert

Agriculture Test Fields „WAGNA“
Lysimeter and Groundwater Research Area

Investigations Results (January 2005 – December 2005)

Johann Fank

April, 15th 2006

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Contents

- **Lysimeter preparation and control**
  - ➔ Preparation for mechanical cultivation
  - ➔ Weighing precision control
- **Tracing experiment (injection and 1st results)**
- **Agriculture**
  - ➔ Crop development
  - ➔ Yield and nutrient content in the plants
- **Water balance evaluation**
- **Solute balance evaluation**
- **Groundwater**

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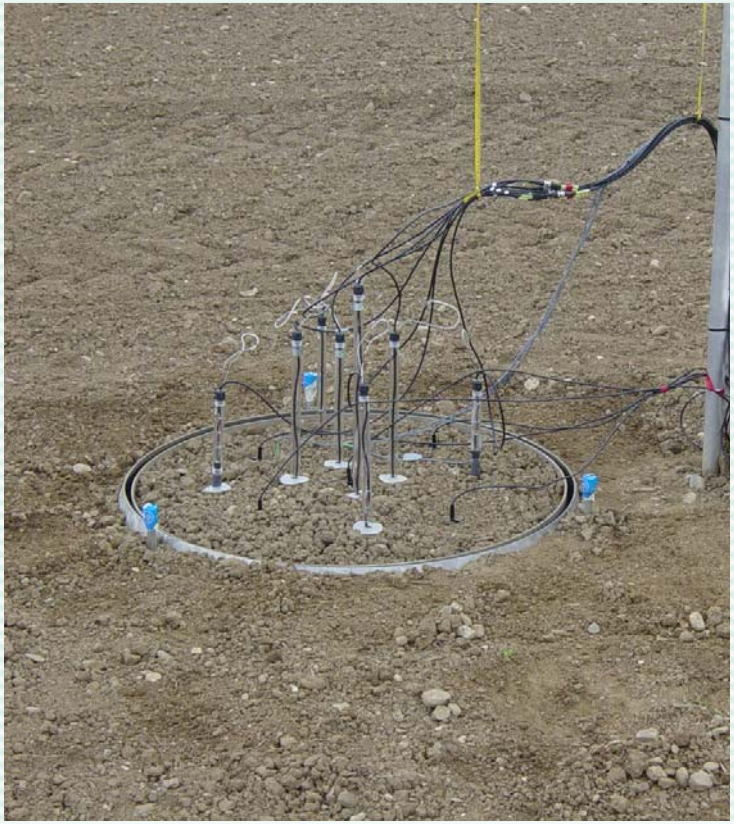
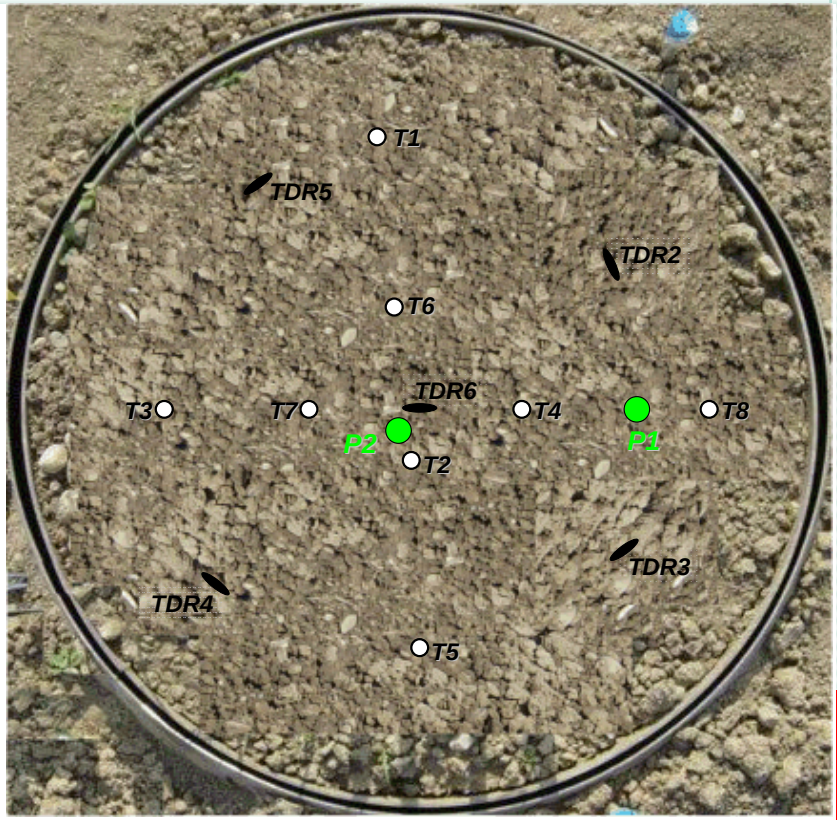
Preparation of the Lysimeter (2005 APR 07)

Calibration, Implementation of Lysimeter (2005 APR 11)

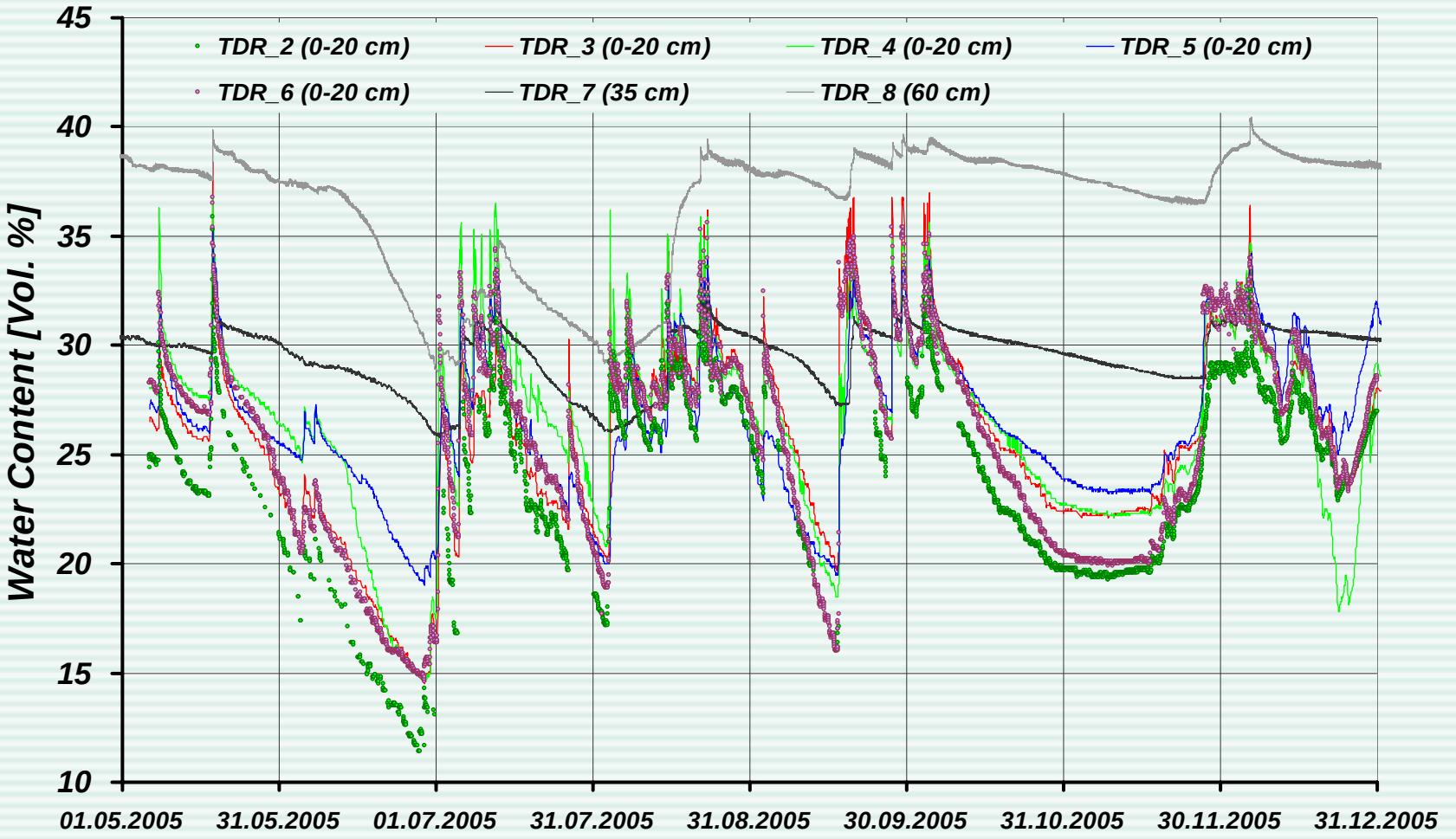
Additional instruments in upper part (2005 MAY 05)



- Pumpkin – Plant (P)
- TDR – Probe (TDR)
- Tensiometer (T)



Water Content (Time Series)



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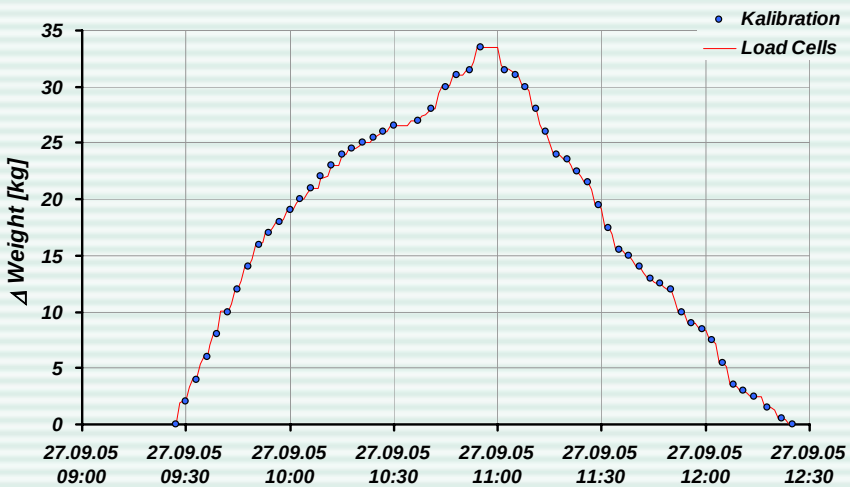
Control of Weighing Precision (2005 SEP 27)



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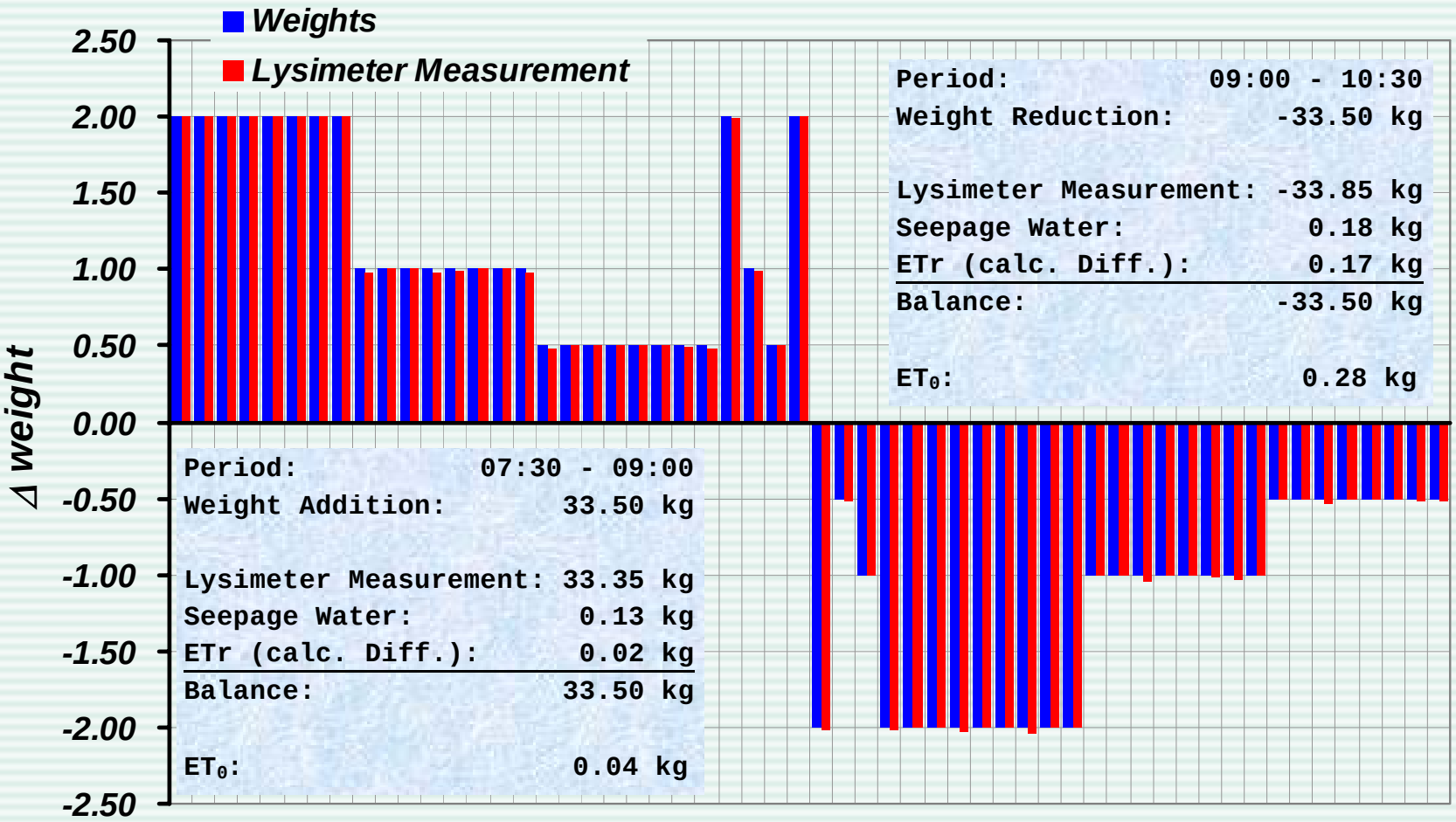
Control of Weighing Precision (2005 SEP 27)



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A Tracing Experiment has been done to detect the Influence of Excavation to Flow Velocity

	ORGANIC FARMING		CONVENTIONAL FARMING	
	Inner Circle	Outer Circle	Inner Circle	Outer Circle
Area [m²]	0.5	0.5	0.5	0.5
Tracer	^{2}H	NaBr	^{2}H	NaBr
Tracer Amount	10 ml 99.8 %	50 g	10 ml 99.8 %	50 g
Solution Amount	1000 ml	1000 ml	1000 ml	1000 ml
Start Time	12.04.2005 16:46	12.04.2005 17:00	12.04.2005 16:53	12.04.2005 17:09
End Time	12.04.2005 16:48	12.04.2005 17:01	12.04.2005 16:55	12.04.2005 17:11
Weight Difference [kg]	0.98	0.98	0.99	0.98

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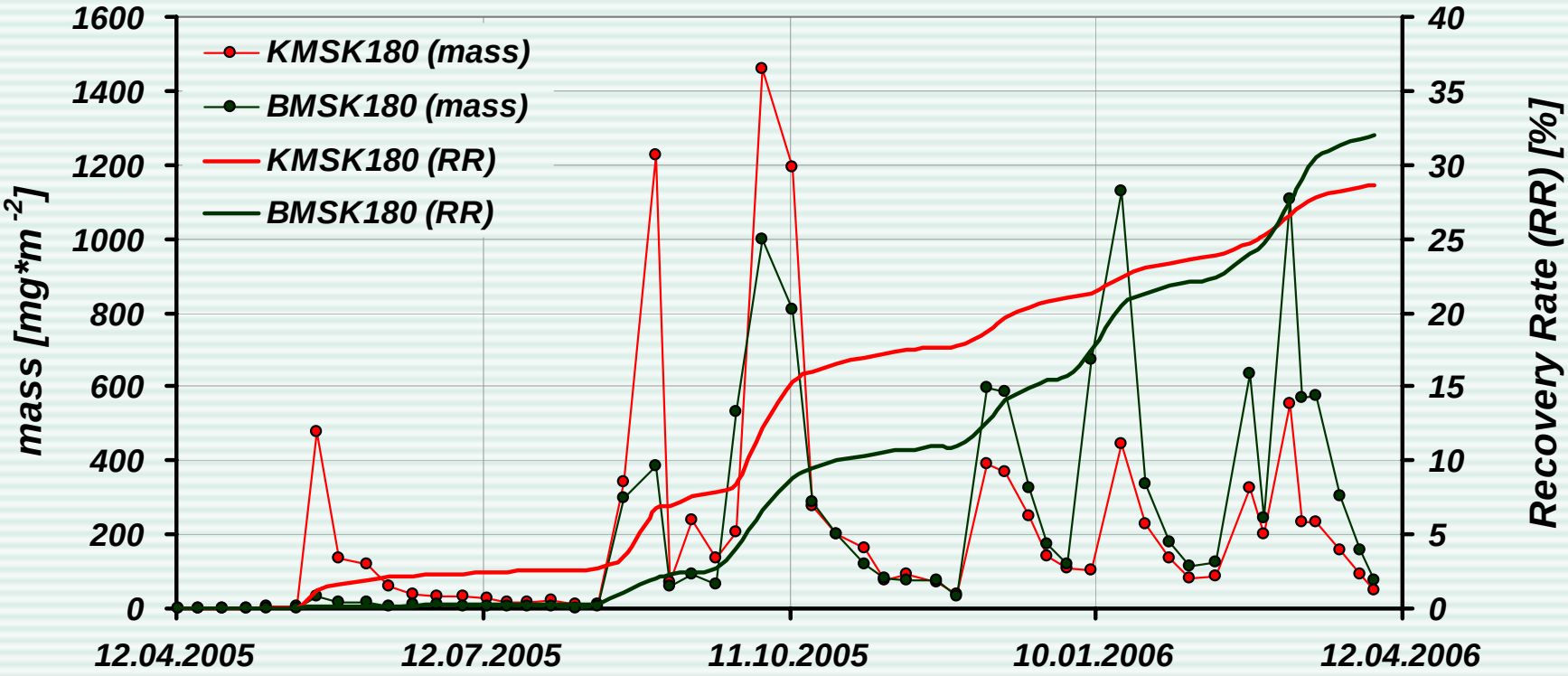
Tracer Breakthrough curves (Comparison of Lysimeters)



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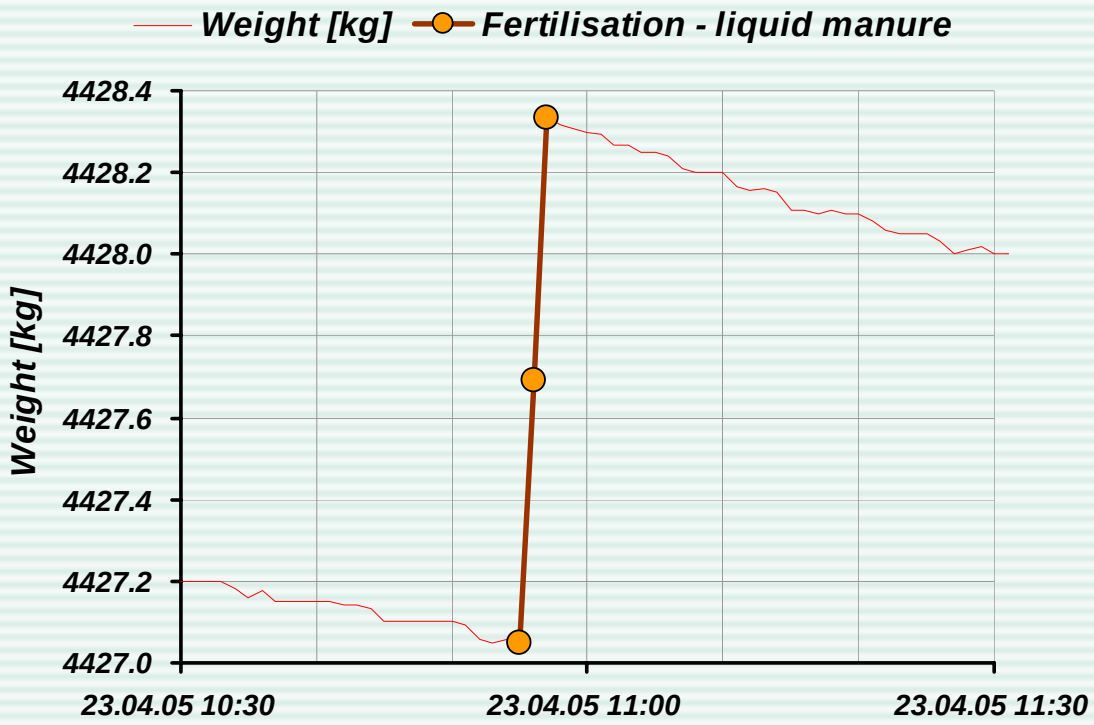
Fertilization with Liquid Manure (conv. Farming 2005 APR 23)



10:55 – 10:57

Δ weight = 1.382 kg

~ 12.830 kg * ha^{-1}

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Crop Development (Lysimeter organic Farming)

- 17.05.2005
- 02.06.2005
- 17.06.2005
- 30.06.2005
- 13.07.2005
- 03.08.2005
- 25.08.2005
- 13.09.2005
- 24.09.2005

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Crop Development (Plot conventional Farming)

02.06.2005, 06.07.2005, 03.08.2005,
25.08.2005, 13.09.2005, 24.09.2005

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Substance content in pumpkins at harvest time (2006 SEP 13)

	organic farming				conventional farming				
Sample	**Tendril**	**Pumpkin seeds**	**Pumpkin pulp**	**cum. sum**	**rotten pumpkin**	**Tendril**	**Pumpkin seeds**	**Pumpkin pulp**	**cum. sum**
Dry weight [kg/m²]	0.030	0.141	0.366	0.537	0.053	0.036	0.091	0.139	0.319
Harvesting weight [kg/m²]	0.033	0.233	6.544	6.810	0.097	0.042	0.147	1.847	2.133
Water content [kg/m²]	0.003	0.092	6.178	6.273	0.044	0.006	0.056	1.708	1.814
Nitrogen (Kjehldahl) [g/100g]	1.560	5.890	1.965		4.890	1.500	5.580	1.595	
[kg/ha]	4.674	82.891	72.010	159.576	25.898	5.450	50.856	22.095	104.299
Phosphorus [g/100g]	0.180	1.000	0.185		1.050	0.300	1.140	0.290	
[kg/ha]	0.539	14.073	6.780	21.392	5.561	1.090	10.390	4.017	21.058
Potassium [g/100g]	0.740	0.520	3.815		1.700	0.930	0.660	4.620	
[kg/ha]	2.217	7.318	139.806	149.341	9.004	3.379	6.015	63.999	82.396
Calcium [g/100g]	4.420	0.050	0.655		0.820	3.590	0.060	0.350	
[kg/ha]	13.244	0.704	24.003	37.951	4.343	13.042	0.547	4.848	22.781
Carbon [g/100g]	61.200	95.300	83.750		86.100	64.000	94.700	82.400	
[kg/ha]	183.380	1341.176	3069.136	4593.692	456.003	232.512	863.096	1141.446	2693.057
Magnesium [g/100g]	0.280	0.390	0.205		0.450	0.260	0.460	0.140	
[kg/ha]	0.839	5.489	7.513	13.840	2.383	0.945	4.192	1.939	9.460
Boron [mg/1000g]	22.400	25.400	48.200		39.500	11.400	22.200	47.250	
[kg/ha]	0.007	0.036	0.177	0.219	0.021	0.004	0.020	0.065	0.111
Manganese [mg/1000g]	316.100	47.800	17.400		115.400	381.600	44.700	7.750	
[kg/ha]	0.095	0.067	0.064	0.226	0.061	0.139	0.041	0.011	0.251
Sodium [mg/1000g]	111.600	13.700	46.550		27.200	138.700	17.600	38.950	
[kg/ha]	0.033	0.019	0.171	0.223	0.014	0.050	0.016	0.054	0.135
Copper [mg/1000g]	12.220	12.250	8.380		15.660	10.350	10.110	7.615	
[kg/ha]	0.004	0.017	0.031	0.052	0.008	0.004	0.009	0.011	0.032
Zinc [mg/1000g]	53.600	99.000	33.850		92.700	51.600	118.800	29.350	
[kg/ha]	0.016	0.139	0.124	0.279	0.049	0.019	0.108	0.041	0.217
Iron [mg/1000g]	8774.000	102.600	288.900		1406.300	10673.900	118.800	120.300	
[kg/ha]	2.629	0.144	1.059	3.832	0.745	3.878	0.108	0.167	4.898

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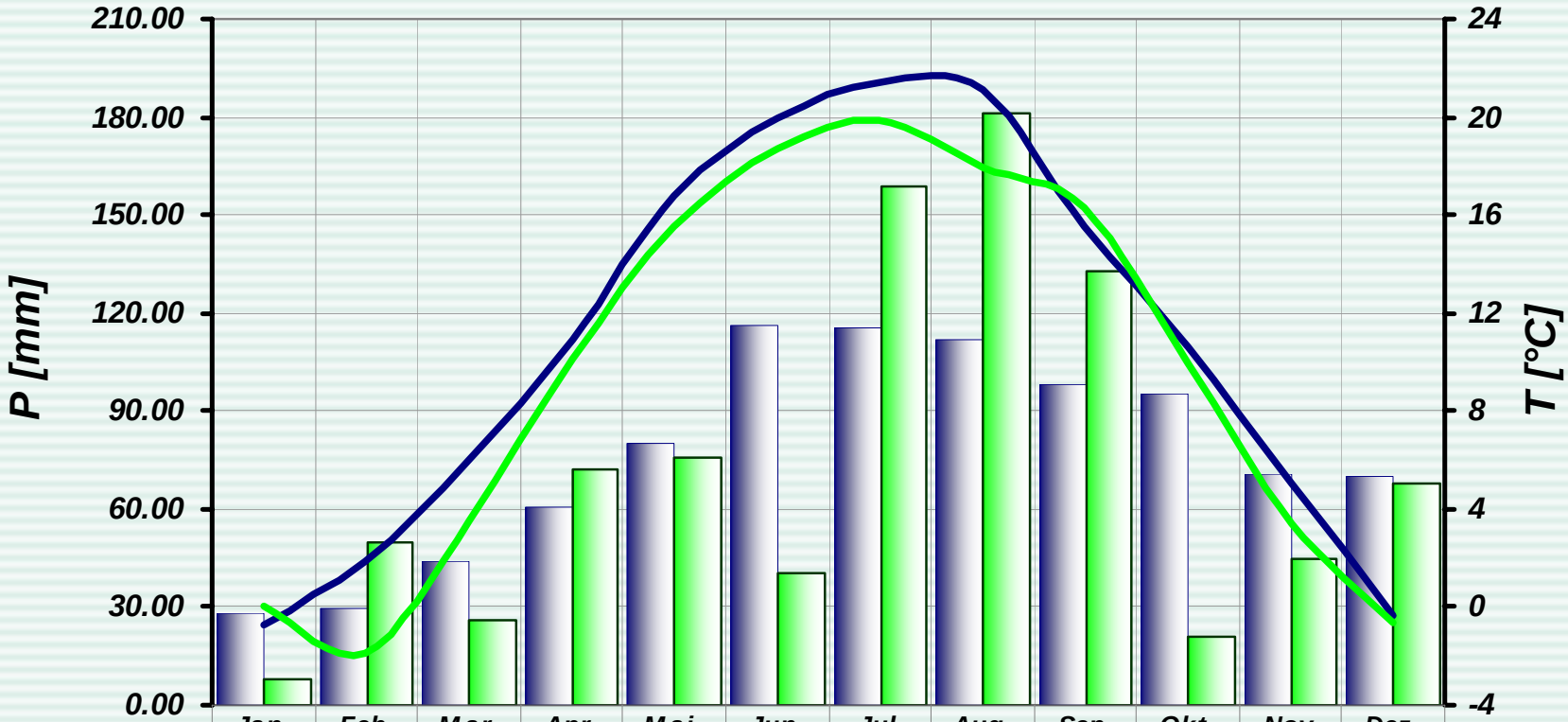
Precipitation and Temperature 2005 compared to 1992 - 2004



	Jan	Feb	Mar	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
P 92/04 (920 mm)	28.19	29.67	43.99	60.93	80.05	116.50	115.17	112.08	97.98	94.98	70.57	70.17
P 2005 (879 mm)	7.70	49.80	26.30	72.00	75.90	40.40	158.90	181.10	132.60	21.00	44.90	68.10
T 92/04 (10.7 °C)	-0.71	1.85	6.04	10.94	16.83	19.98	21.37	21.15	15.49	10.66	5.02	-0.30
T 2005 (9.4 °C)	0.00	-1.91	3.52	10.17	15.50	18.75	19.90	17.93	16.32	9.99	3.43	-0.63

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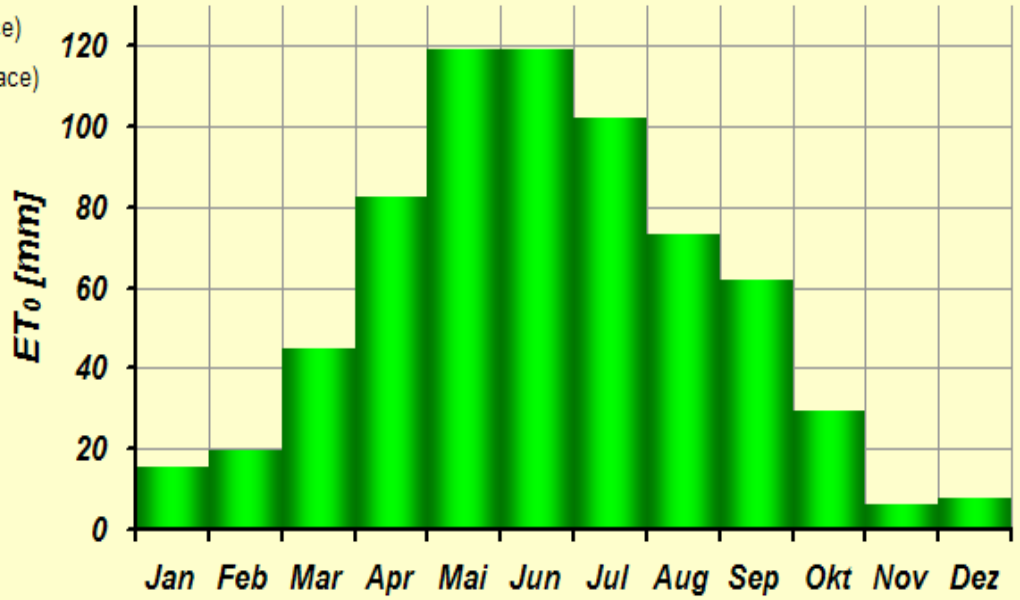
Weather data 2005 calculated ET_0

	Jan	Feb	Mar	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez	Jahr
Ta [°C]	0.0	-1.9	3.5	10.2	15.5	18.7	19.9	17.9	16.3	10.0	3.4	-0.6	**9.4**
Hr [%]	81.1	79.2	74.0	65.9	64.6	63.7	76.9	81.3	84.1	86.2	91.3	85.2	**77.8**
Ws [m/s]	0.7	0.7	0.9	1.3	1.3	1.2	0.9	0.7	0.6	0.6	0.6	0.6	**0.8**
Rn [MJ/m²]	166.7	227.1	370.6	498.3	652.8	638.7	557.6	441.6	383.3	237.9	100.5	112.3	**4387.4**
ET_0 [mm]	15.5	19.7	44.6	82.4	119.2	119.3	102.1	73.0	62.0	29.4	6.2	7.9	**681.4**

Ta air temperature (2 m above surface)
Hr relative humidity (2 m above surface)
Ws wind speed (2 m above surface)
Rn net radiation (2 m above surface)
ET_0 grass reference evapotranspiration (FAO)



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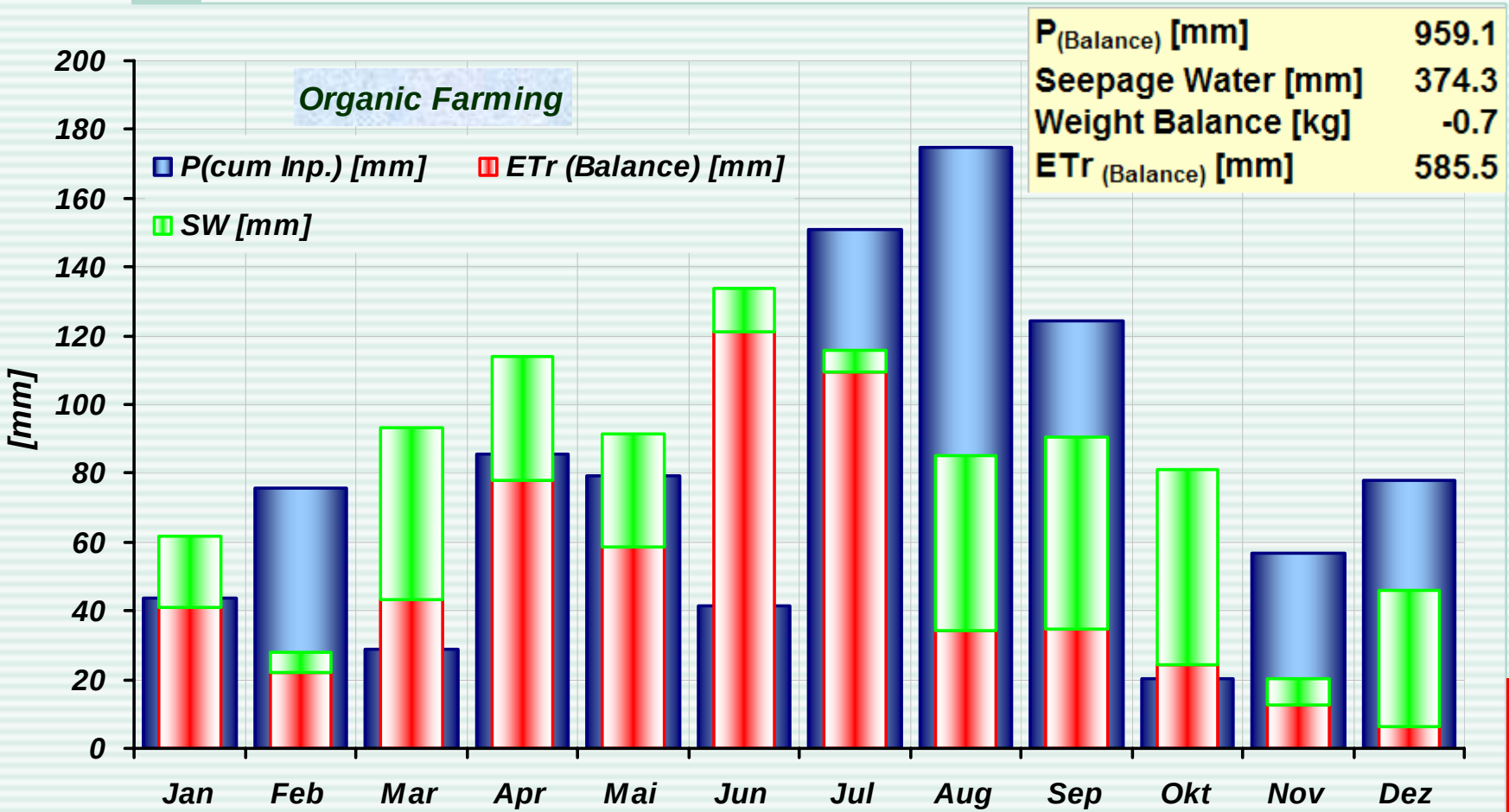
Water Balance 2005 (organic farming)



$P_{(Balance)}$ [mm]	959.1
Seepage Water [mm]	374.3
Weight Balance [kg]	-0.7
$ETr_{(Balance)}$ [mm]	585.5

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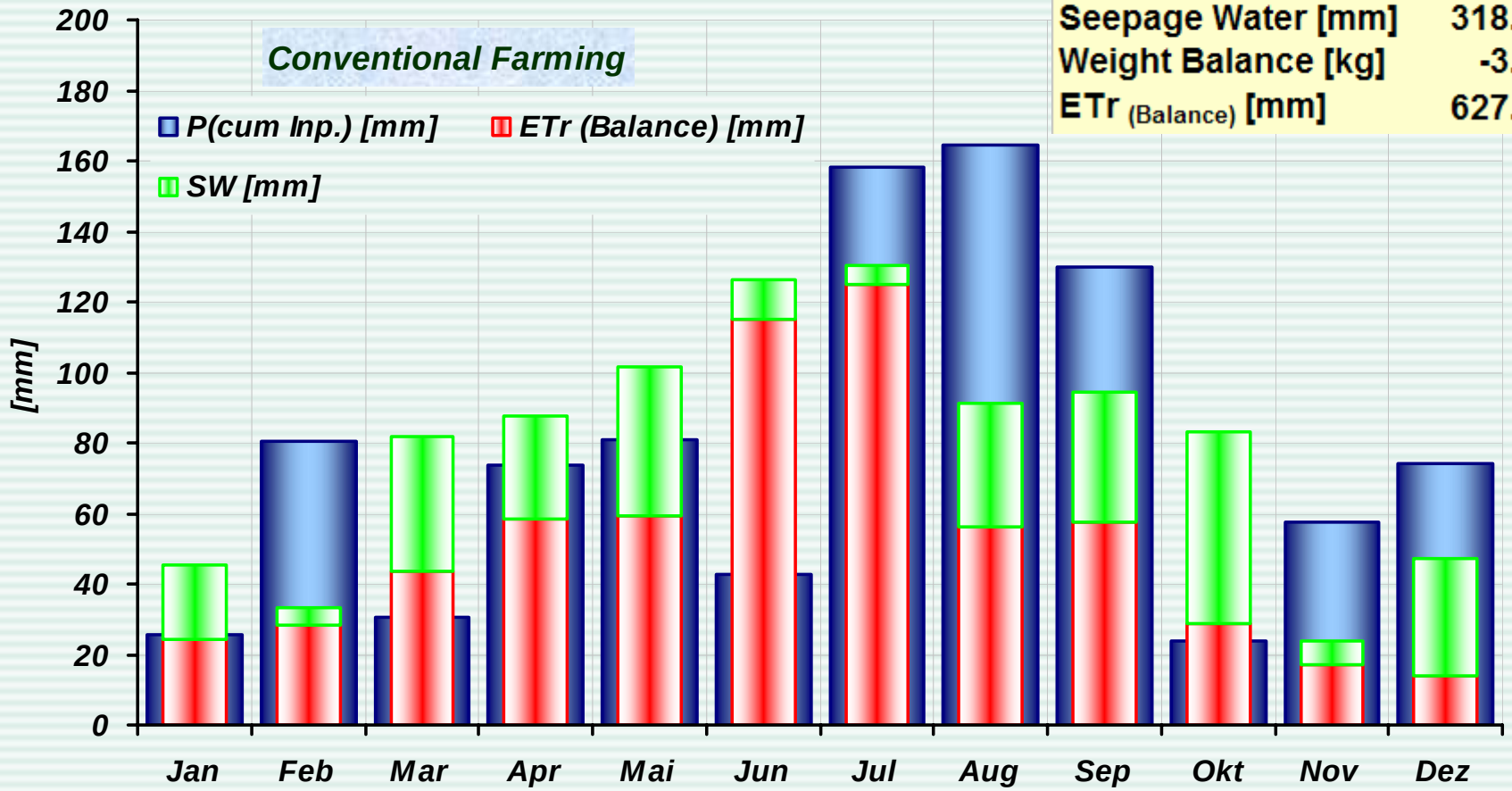
Water Balance 2005 (conventional farming)

$P_{(Balance)}$ [mm]	943.0
Seepage Water [mm]	318.4
Weight Balance [kg]	-3.2
$ETr_{(Balance)}$ [mm]	627.8



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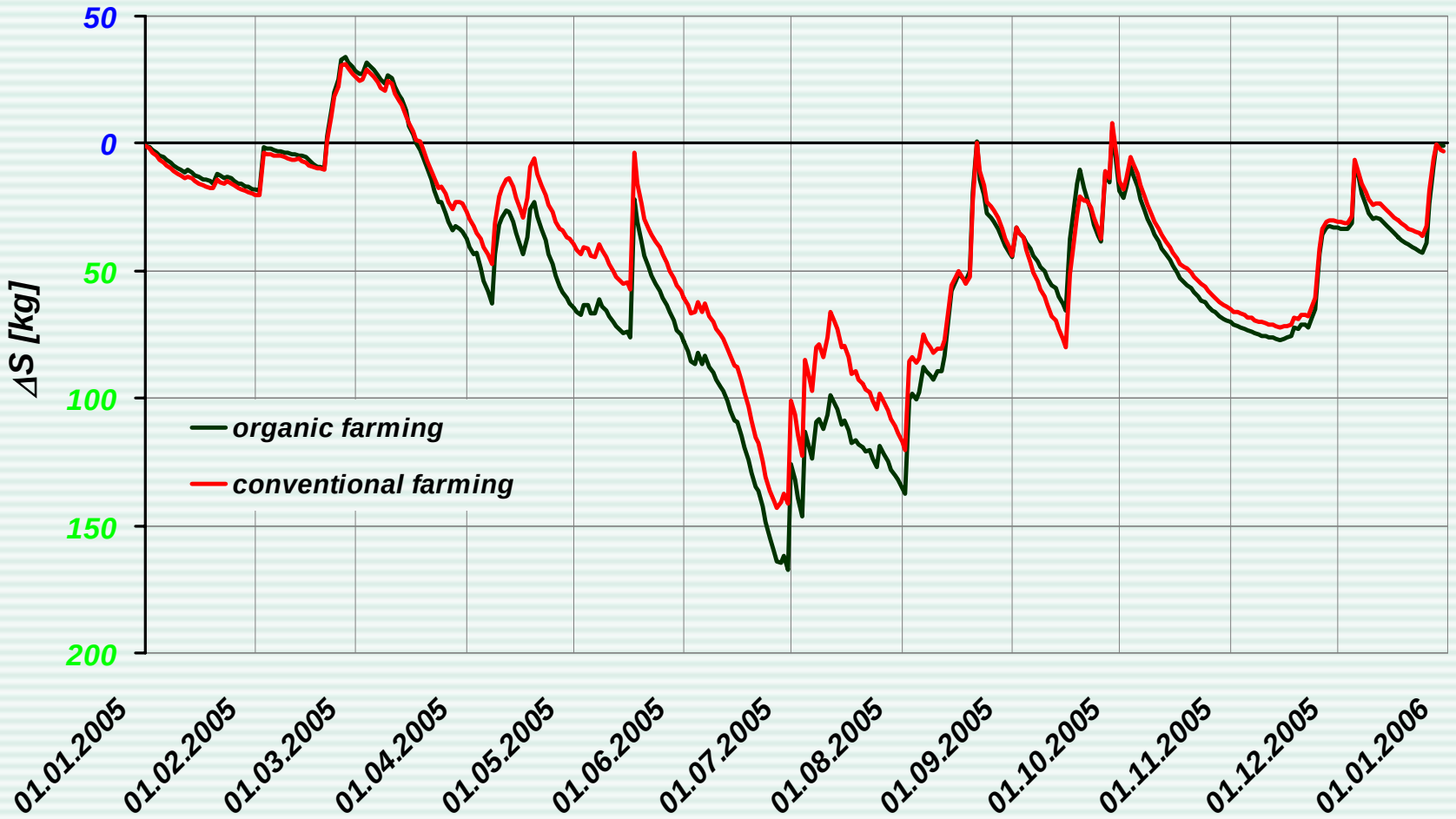
Change of stored water volume (comparison of 2 lysimters)



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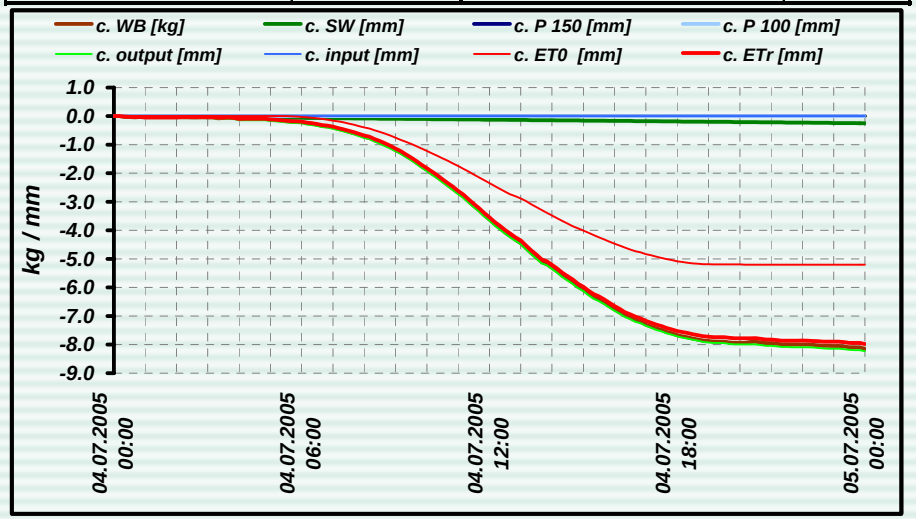
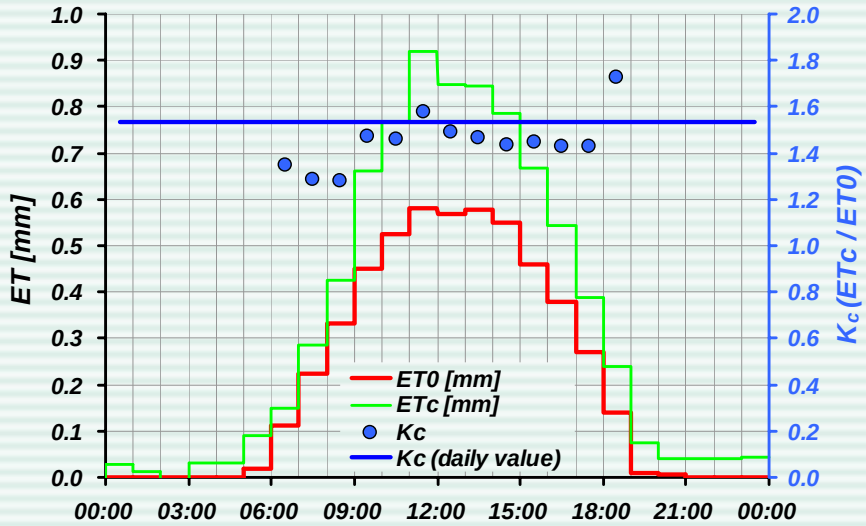
Daily water balance (2005 JUL 04)

- **Water balance paramters calculated from lysimeter weights, seepage water measurement and meteorological data**

conventional cultivation		04. Jul. 2005	
Prec. P_{150} [mm]	0.00	Weight Balance WB [kg]	-8.14
Prec. P_{100} [mm]	0.00	$ETr_{(P100 - SW - WB)}$ [mm]	7.89
Prec. $P_{(cum. Input)}$ [mm]	0.00	$ET_{0 (FAO)}$ [mm]	5.20
Seepage Water SW [mm]	0.25	$ETr_{(cum. output - SW)}$ [mm]	7.98



- **ET_0 calculated using meteorological data**
- **ETc from lysimeter weights**
- **Crop coefficient ($Kc = ETr/ET_0$)**
  - ➔ Daily value
  - ➔ Hourly values



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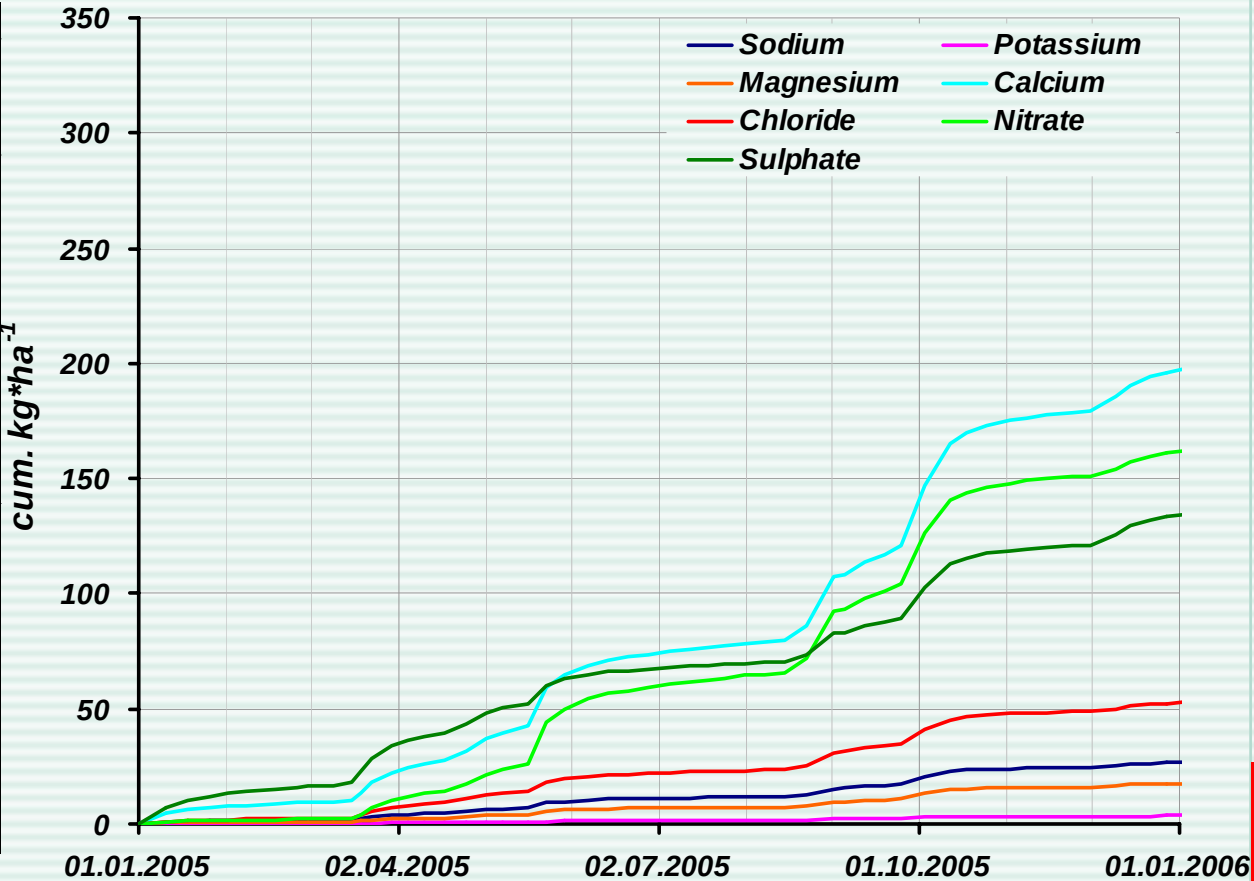
Solute Balance Lysimeter 1

Parameter	Unit	Lysimeter 1
cum. Sum of SW	mm	310
mean value of el. cond.	µS*cm^{-1}	386
mean value of pH	-	7.35
Leaching		
Sodium	kg*ha^{-1}	26.65
Potassium	kg*ha^{-1}	3.59
Magnesium	kg*ha^{-1}	17.74
Calzium	kg*ha^{-1}	197.36
Chloride	kg*ha^{-1}	52.68
Nitrate	kg*ha^{-1}	161.80
Sulphate	kg*ha^{-1}	134.25
Mean Concentration measured		
Sodium	mg*l^{-1}	8.07
Potassium	mg*l^{-1}	1.07
Magnesium	mg*l^{-1}	5.29
Calzium	mg*l^{-1}	58.67
Chloride	mg*l^{-1}	15.66
Nitrate	mg*l^{-1}	48.46
Sulphate	mg*l^{-1}	43.12



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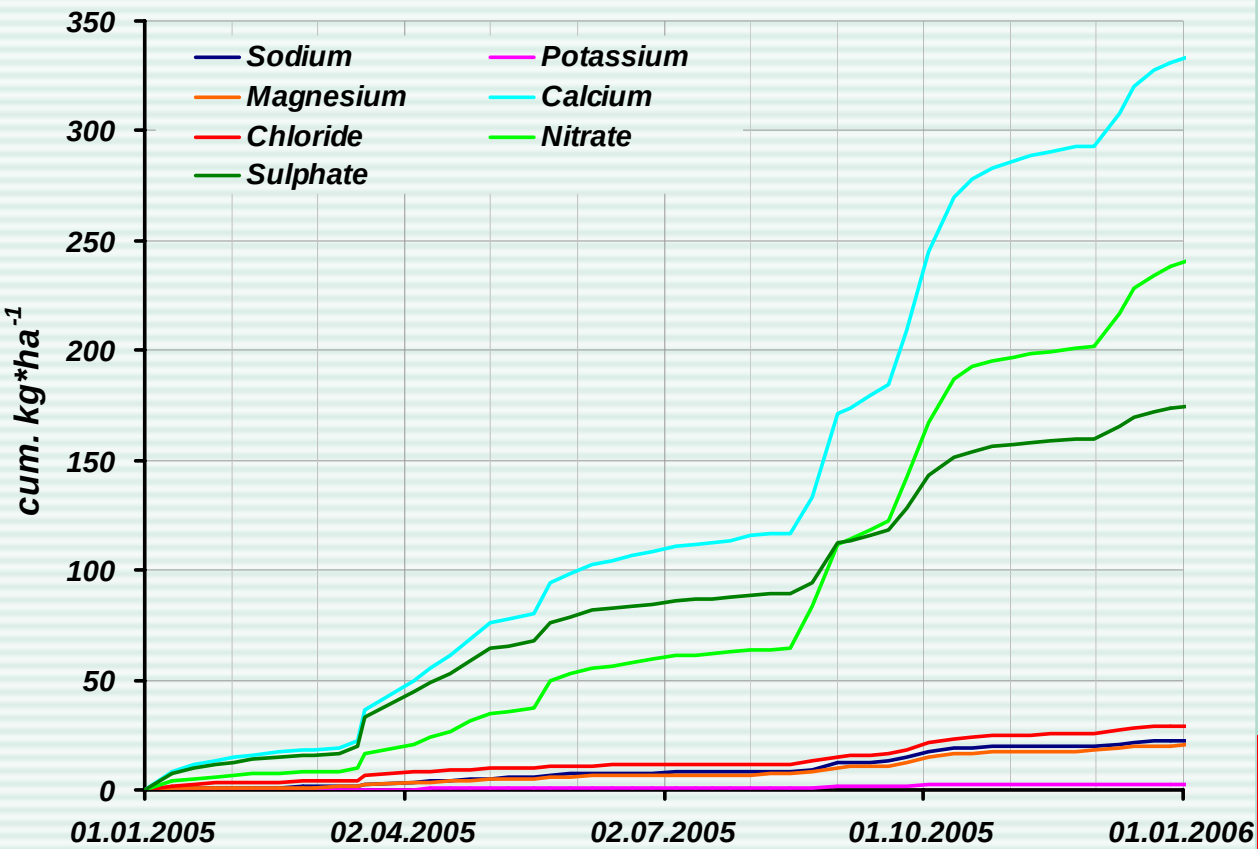
Solute Balance Lysimeter 2

Parameter	Unit	Lysimeter 2
cum. Sum of SW	mm	364
mean value of el. cond.	µS*cm^{-1}	480
mean value of pH	-	7.42
Leaching		
Sodium	kg*ha^{-1}	22.30
Potassium	kg*ha^{-1}	2.65
Magnesium	kg*ha^{-1}	20.38
Calzium	kg*ha^{-1}	333.86
Chloride	kg*ha^{-1}	29.30
Nitrate	kg*ha^{-1}	240.51
Sulphate	kg*ha^{-1}	174.42
Mean Concentration measured		
Sodium	mg*l^{-1}	5.77
Potassium	mg*l^{-1}	0.66
Magnesium	mg*l^{-1}	5.25
Calzium	mg*l^{-1}	86.06
Chloride	mg*l^{-1}	7.62
Nitrate	mg*l^{-1}	57.80
Sulphate	mg*l^{-1}	47.38



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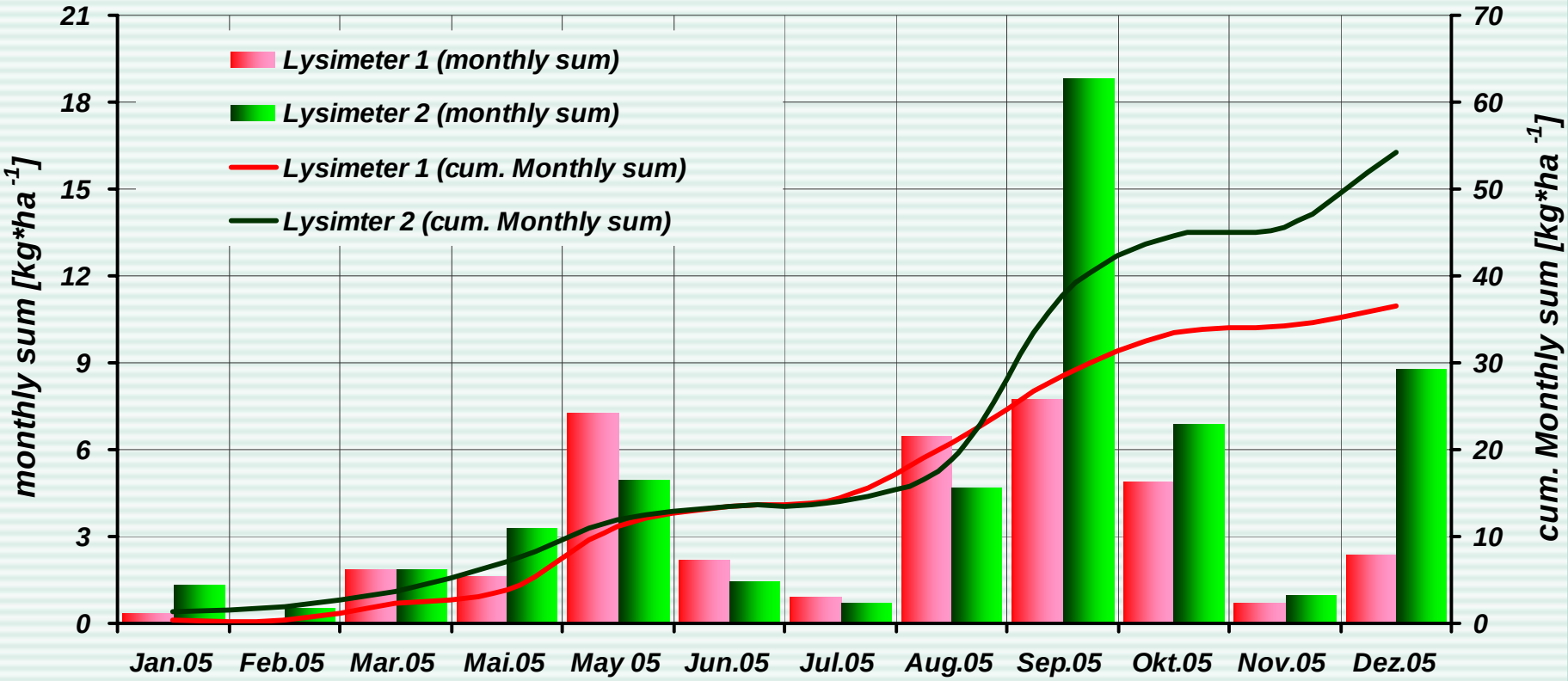
Nitrogen Leaching to GW



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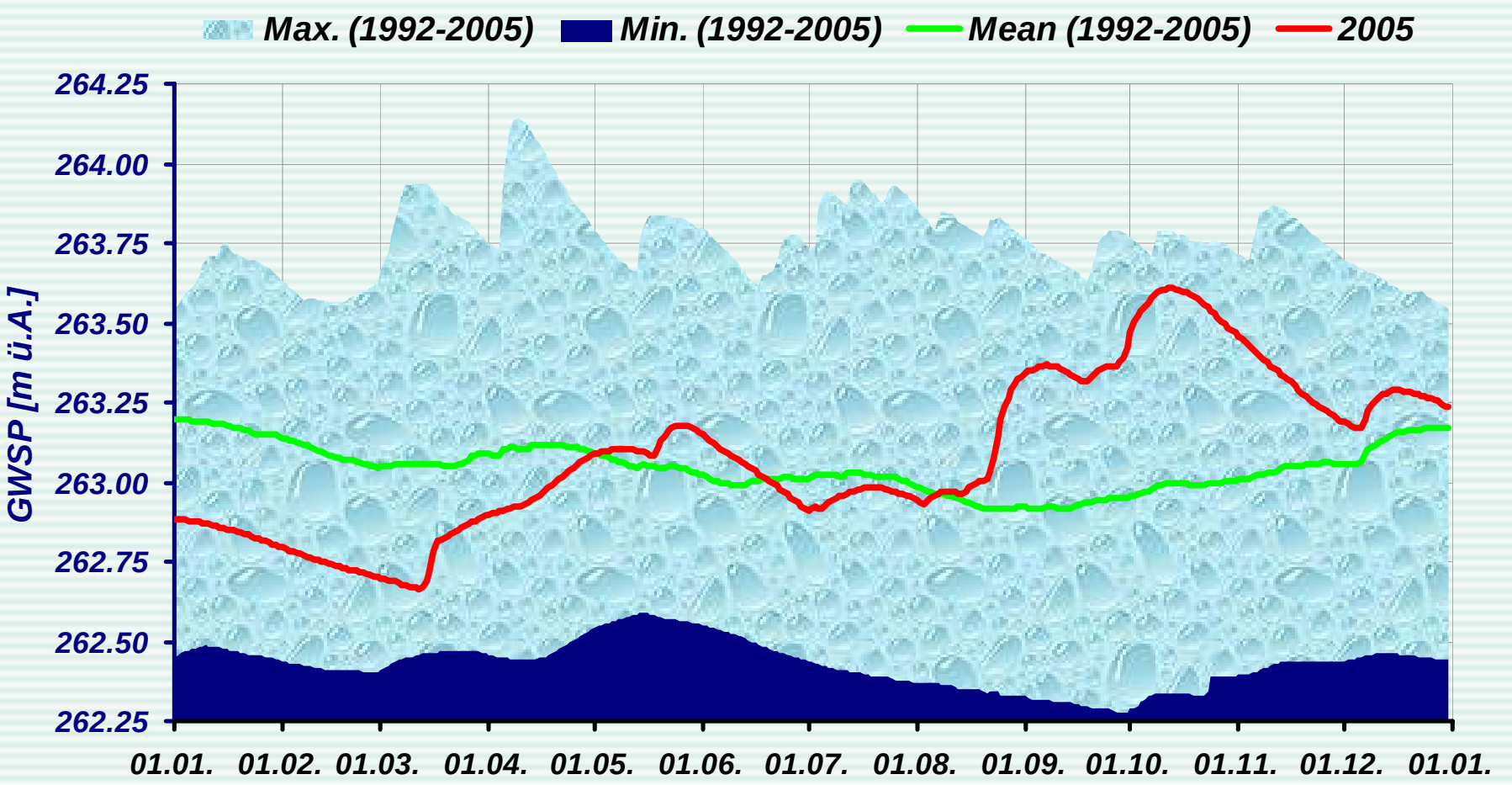
GW – Table Elevation



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GW – Nitrate Concentration (1992 – 2005)