Five-year applications of OMW to an intensive olive orchard
Effects on soil properties and tree performance

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Experimental set-up

	12	11	10	9	8	
20						20
19	25B	20B	15B	10B	5B	19
18	25A	20A	15A	10A	5A	18
17						17
16						16
15	24B	19B	14B	9B	4B	15
14	24A	19A	14A	9A	4A	14
13						13
12						12
11	23B	18B	13B	8B	3B	11
10	23A	18A	13A	8A	3A	10
9						9
8						8
7	22B	17B	12B	7B	2B	7
6	22A	17A	12A	7A	2A	6
5						5
4						4
3	21B	16B	11B	6B	1B	3
2	21A	16A	11A	6A	1A	2
1						1
	12	11	10	9	8	

150 m^3 OMW/ ha. — 4

Control Without OMW — 1

100 m3 OMW/ ha.+ Tillage — 5

50 m^3 OMW/ ha. — 2

100 m^3 OMW/ ha. — 3

- The orchard was planted in 2004
- Sandy loam soil
- Leccino cultivar
- Randomized blocks
- 5 replicates
- 2 measured trees per replicate
- 5 consecutive years of OMW application

Treatments and samplings

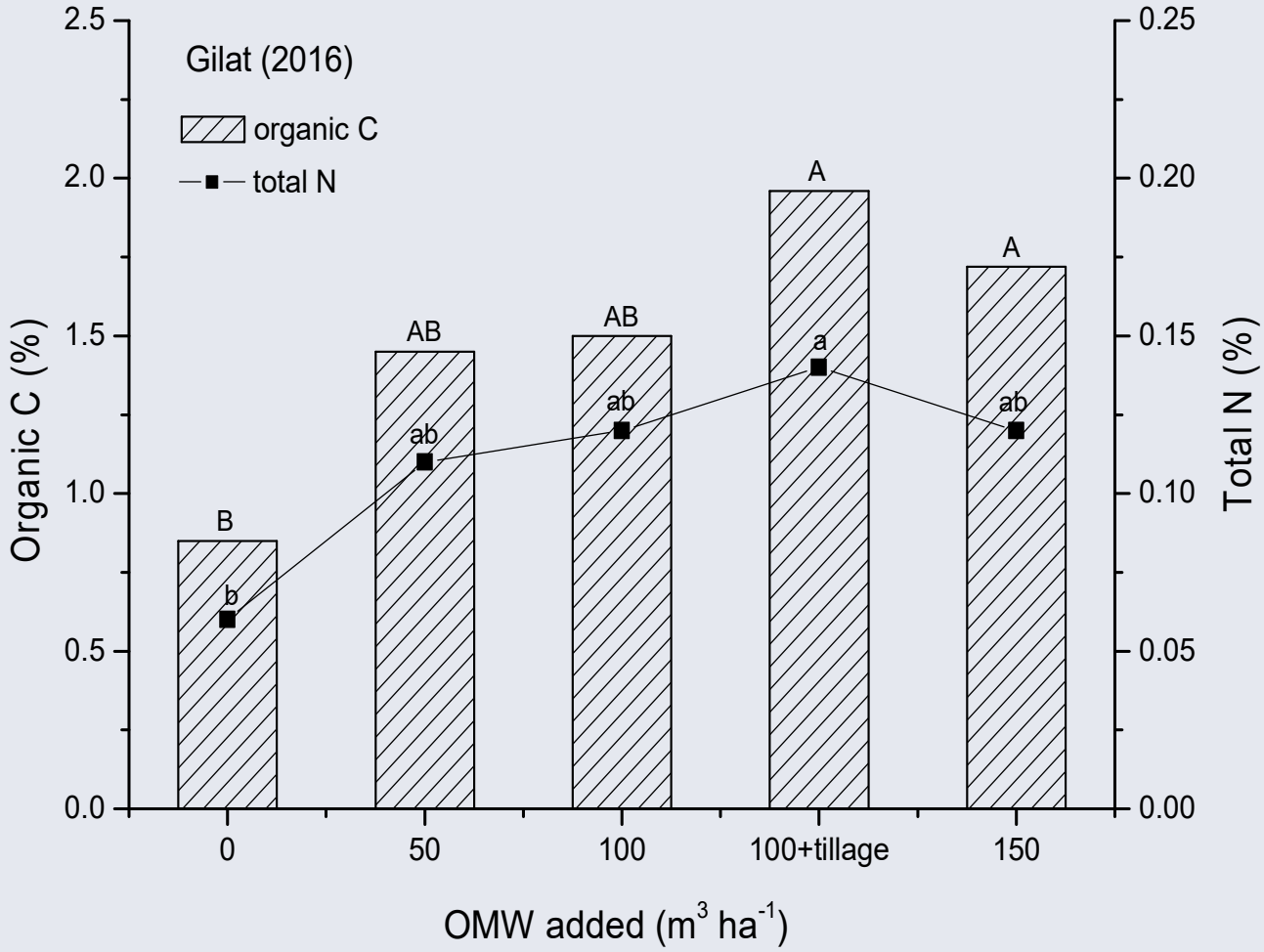
- 2004-2011 standard irrigation and fertilization
- 2012-2016 standard irrigation without fertilization
- Irrigation with drippers, once-twice a week
- Application of OMW in January every year
- Tillage was performed in March

  (in the relevant treatment)
- Soil sampling- before and after OMW application
- Leaf sampling in July

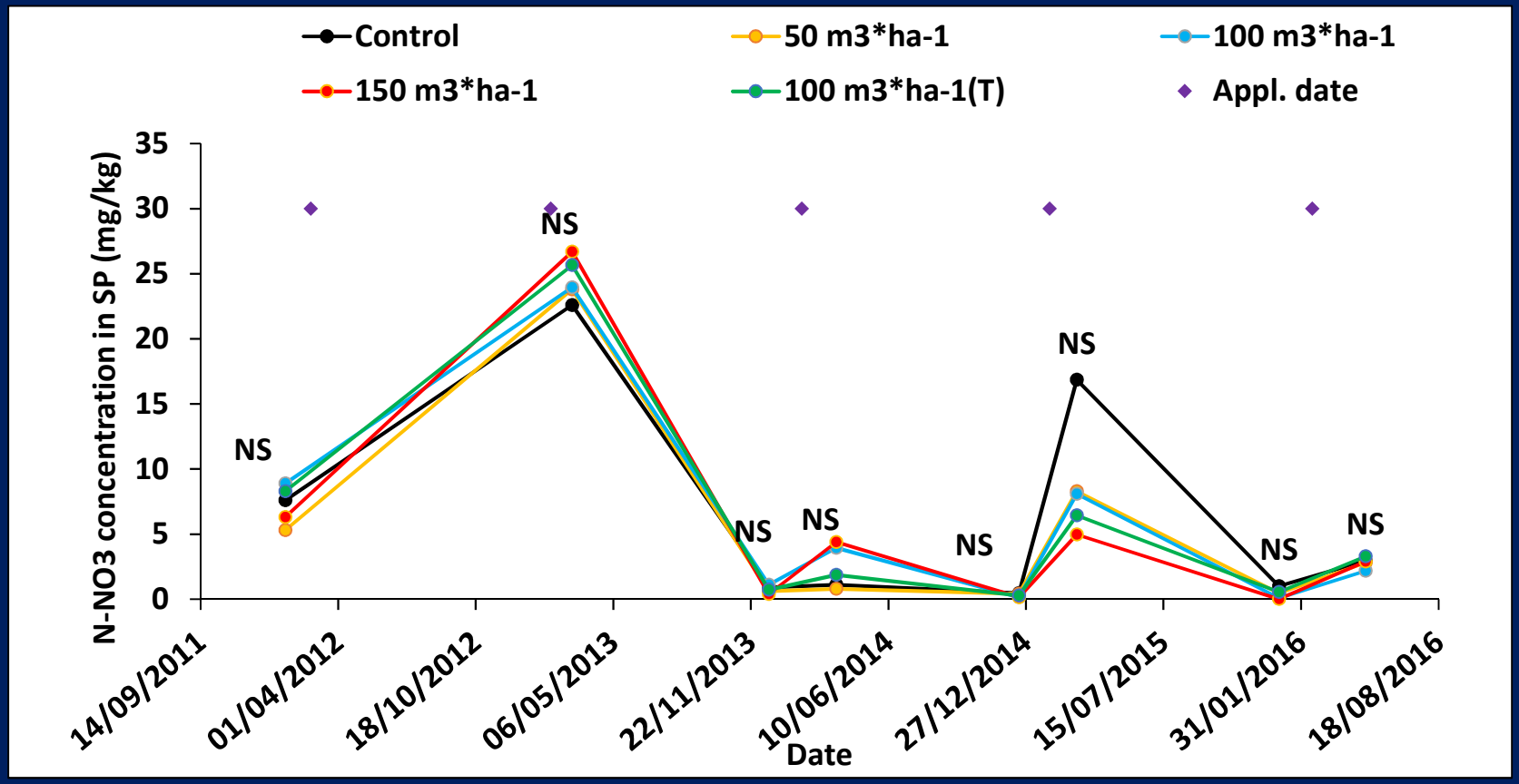
Composition of OMW used in the experiment (average for 5 years)

	pH	EC (ds/m)	Cl (meq/l)	Na (meq/l)	Ca (meq/l)	Mg (meq/l)	N-NO3 (mg/l)	N-NH4 (mg/l)	total N (mg/l)	soluble P (mg/l)	total P (mg/l)	K (mg/l)	Fe (mg/l)	Zn (mg/l)	Mn (mg/l)	Cu (mg/l)	TS (g/l)
Avg.	4.4	12.5	27.9	14.8	13.3	14.7	14.1	37.1	949	217.6	293.8	5375	26.9	7.5	2.4	0.6	75.1
SD	0.3	1.0	4.0	6.7	13.4	1.8	6.0	17.8	439	67.2	70.9	1006	20.3	8.7	1.2	0.7	20.1

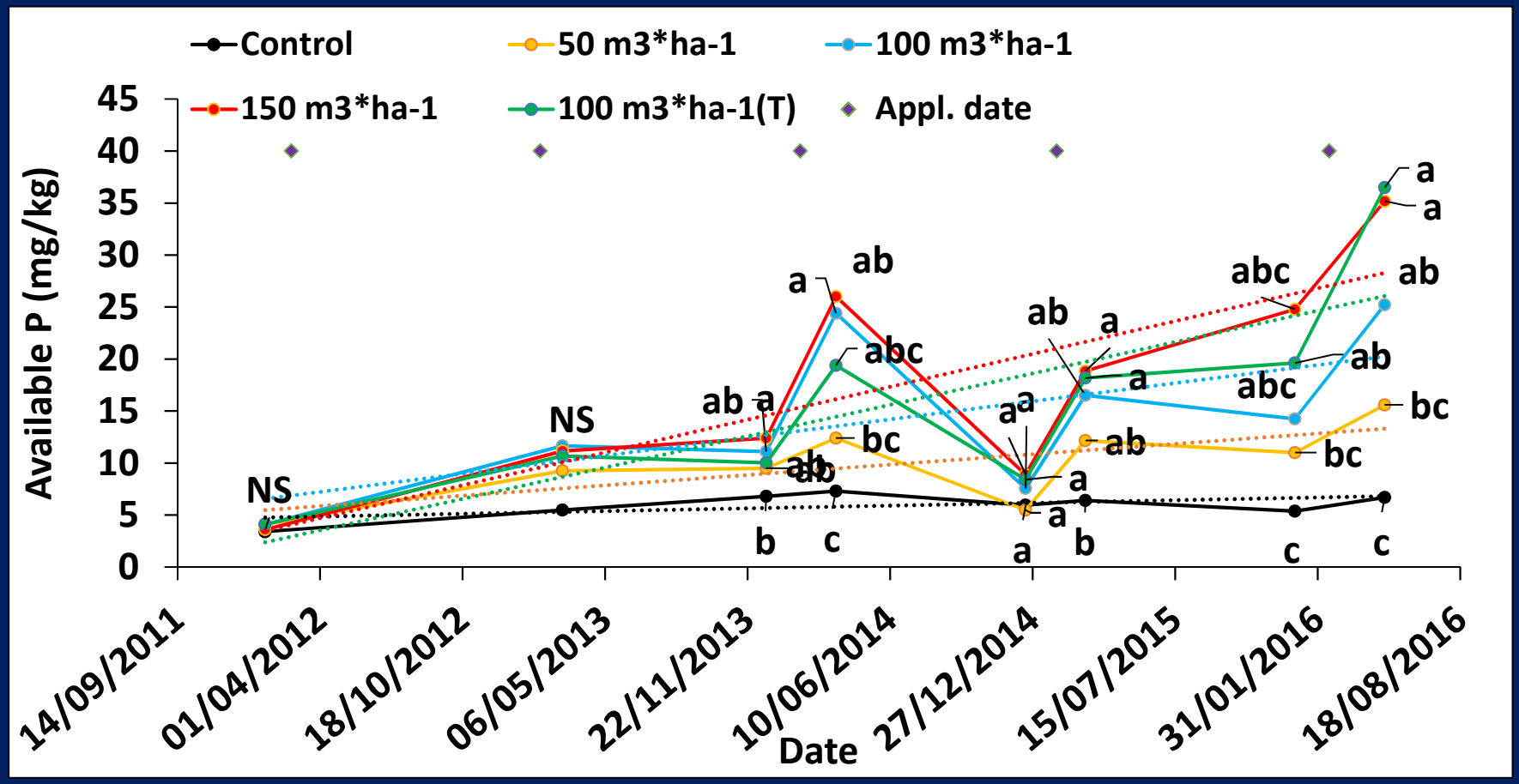
Organic C and total N content in soil samples, 0-10 cm depth (end of the experiment, 2016)



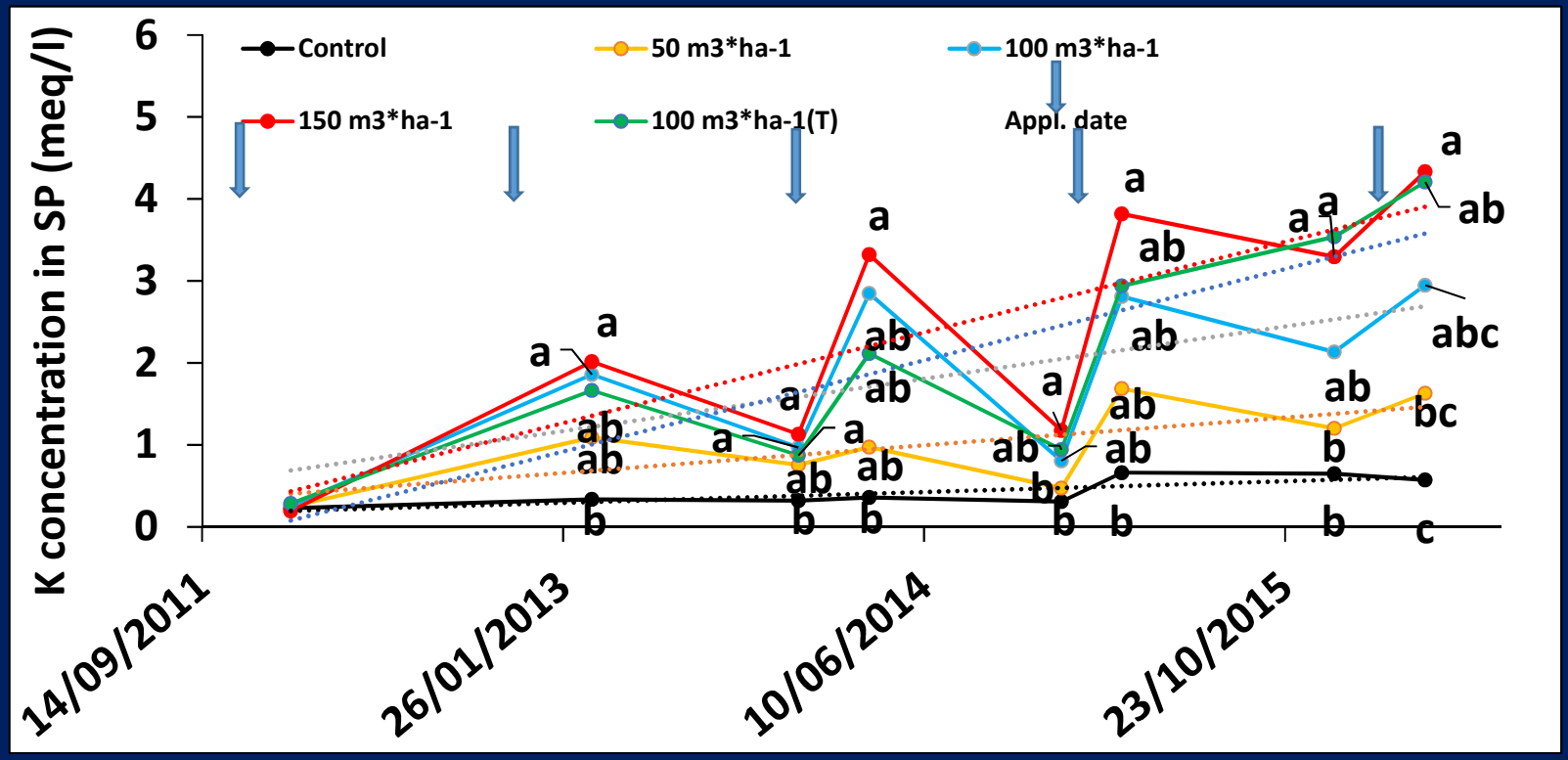
$N\text{-}NO_3$ in soil analysis at 0-30 cm depth (saturated paste extraction)



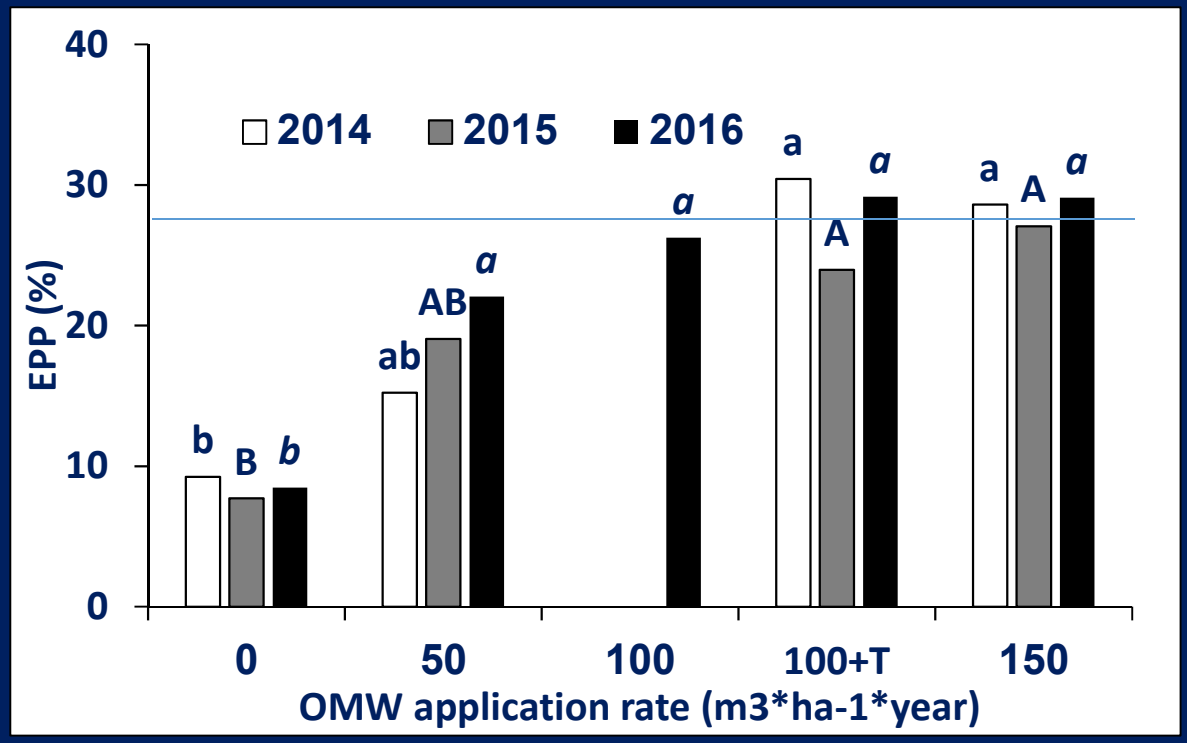
P in soil analysis at 0-30 cm depth (Olsen analysis)



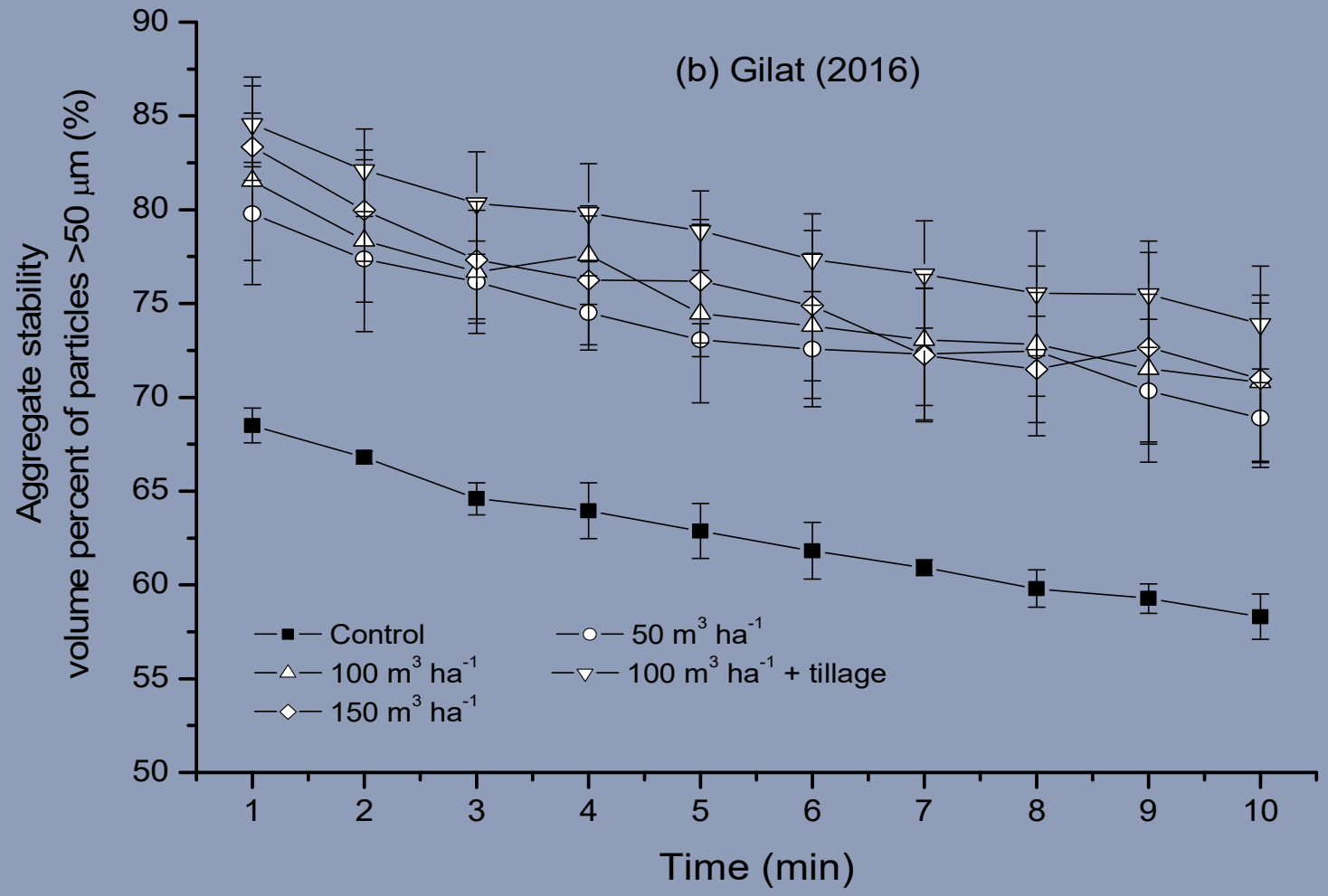
K in soil analysis at 0-30 cm depth (saturated paste extraction)



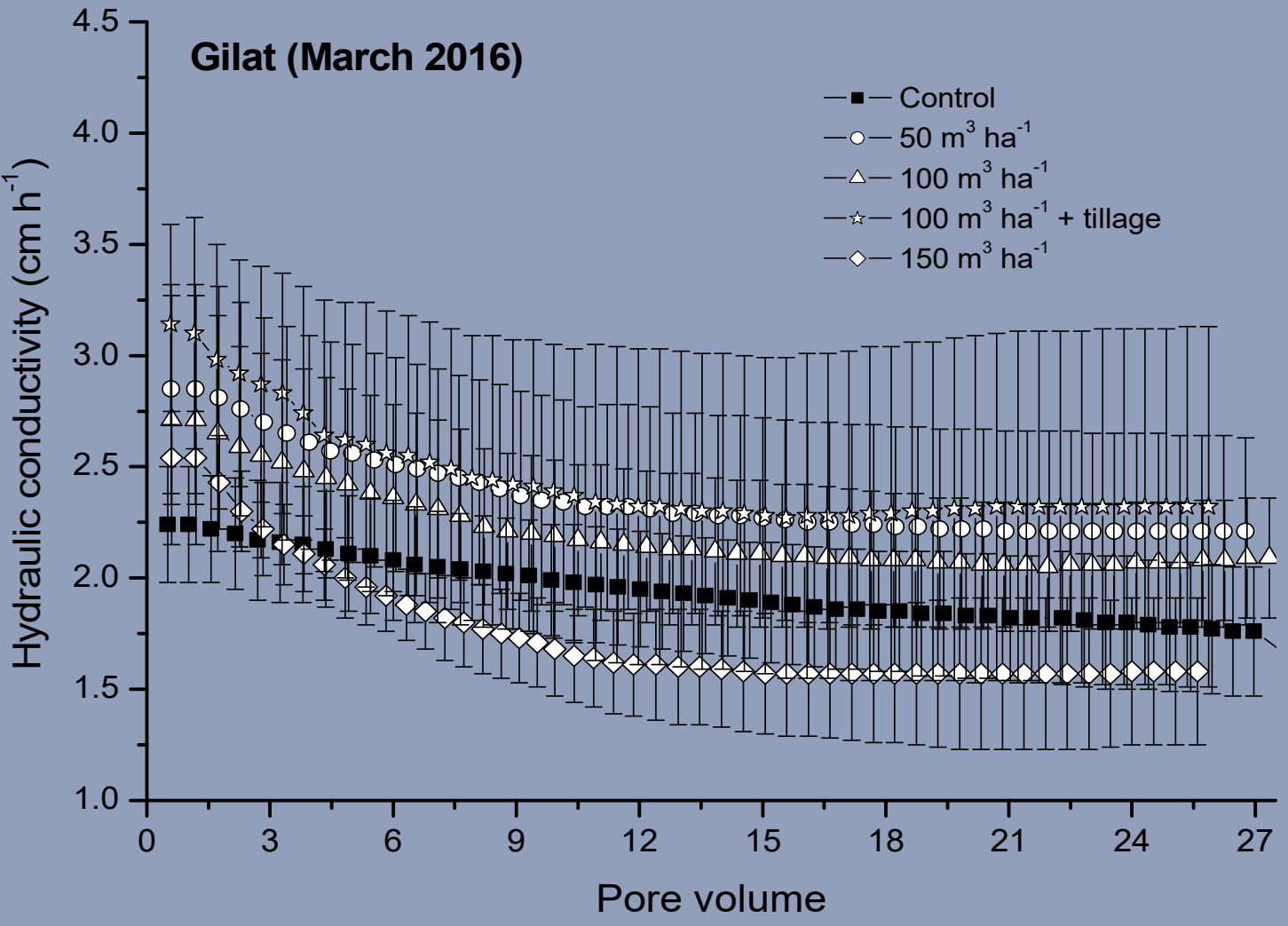
Exchangeable potassium in the soil at 0-10 depth



Aggregate stability (expressed as volume percent of particles >50 µm)

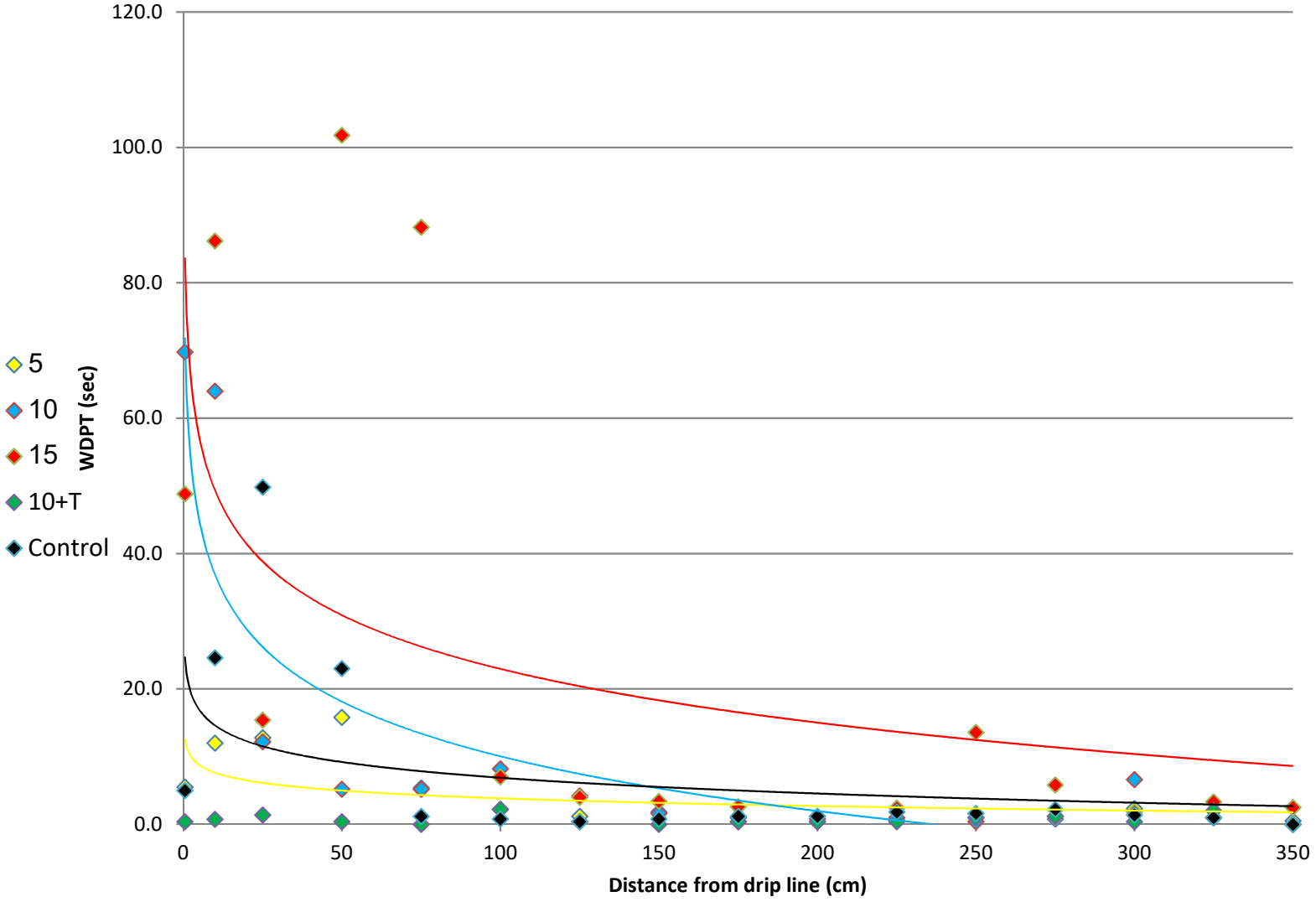


Effects of the different levels of annual OMW addition on .the hydraulic conductivity , 2016




Soil hydrophobicity

Effects of the different levels of annual OMW addition on soil hydrophobicity, 2014.



The effect of the OMW treatment on vegetative growth, yield and oil quality along the 5 years of the experiment

Treatment	The change in trunk cross section 2012-6 (%)	Accumulated yield (kg / tree)	Free Fatty Acids in oil (%)	Polyphenols in oil (mg/ kg)
0	52.7 a	55.6 a	0.18 a	80.0 a
5	57.5 a	37.0 a	0.21 a	68.0 a
10	55.7 a	43.0 a	0.20 a	75.0 a
15	55.2 a	51.7 a	0.17 a	71.0 a
10+T	58.9 a	41.3 a	0.19 a	75.0 a

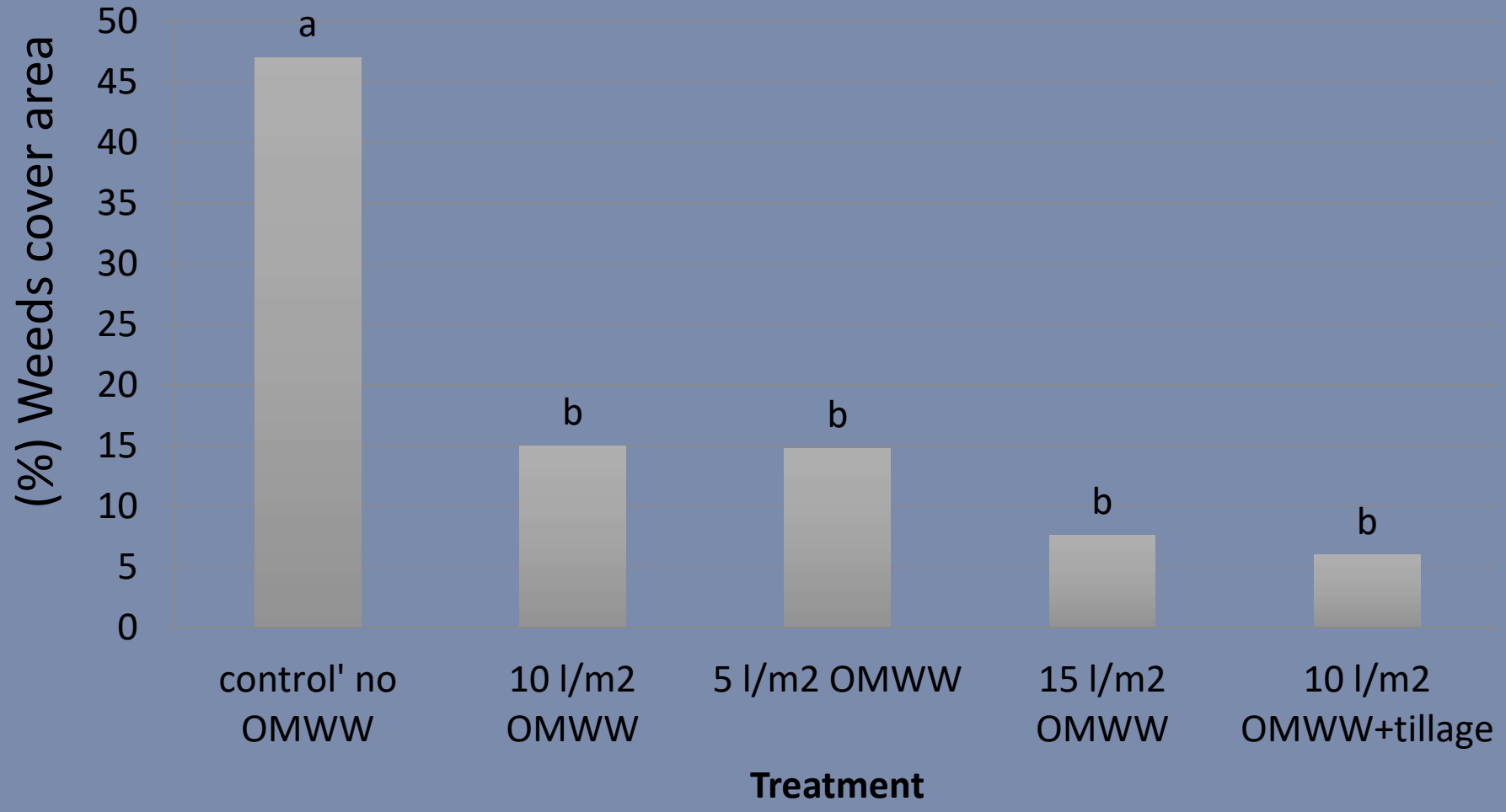
The effect of OMW treatment on N, P and K in leaves

Treatment	2013 (% in DW)			2016 (% in DW)		
	N	P	K	N	P	K
0	1.32 aA	0.10 aA	1.20 aA	1.08 aB	0.08 aB	1.02 aB
5	1.30 aA	0.09 aA	1.17 aA	1.11 aB	0.09 aA	1.19 abA
10	1.30 aA	0.09 aA	1.18 aA	1.08 aB	0.09 aA	1.12 abA
15	1.24 aA	0.09 aA	1.18 aA	1.17 aB	0.10 aA	1.24 bA
10+T	1.31 aA	0.09 aA	1.18 aA	1.10 aB	0.09 aA	1.17 aA

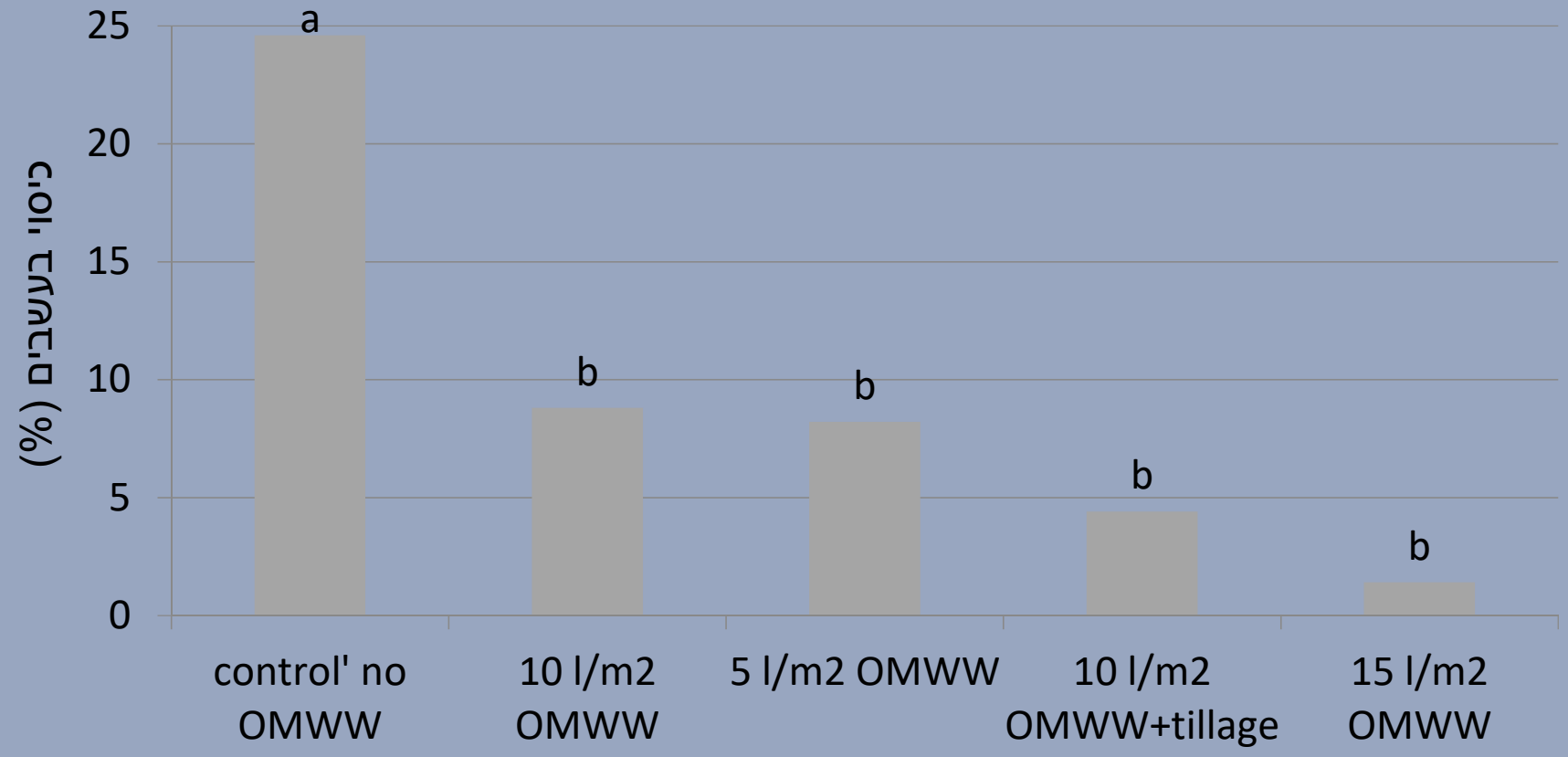
Evaluation of OMW contribution to the olive orchard nutrition (50 m^3 / ha.)

	P_2O_5	K_2O
Amount of nutrient (kg ha^{-1} y^{-1})	25	323
Cost ($ kg^{-1})	2.5	1.7
Potential saving ($ ha^{-1} y^{-1})	62.5	549.1
Total Potential Saving ($ ha^{-1} y^{-1})	611.6	

Effect of OMW applications on weed control, May 2014



Effect of OMW applications on weed control, May 2015



Summary – the effect of 5 years of OMW application

- OMW effectively control weeds
- OMW supplied substantial amounts of P and K and negligible amounts of N.
- OMW application didn’t affect yield and oil quality.
- OMW application increased EPP but didn’t affect aggregate stability and soil hydraulic conductivity.
- OMW application increased soil hydrophobicity.

Phytotoxic effect because of uncontrolled OMW application in an olive orchard in Negba

Phytotoxic effect because of uncontrolled OMW application in an olive orchard in the Negev Highlands

Application of two phase olive mill waste in Megido olive orchard

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Impact of spreading olive mill wastewater on olive tree performance, Soil properties and environment