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COORDINATED USE OF MARGINAL WATER RESOURCES IN ARID AND DESERT AREAS

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As described in our previous report, *Acacia Saligna* L. seedlings were planted in February 1994 in the experimental agroforestry site, of The Jacob Blaustein Institute for Desert Research (Sede Boqer Campus, The Ben-Gurion University of the Negev). The experiment consisted of 11 treatments in three replicates, which are briefly described in Table 1.

Treatment code	Threshold for irrigation Pre-dawn LWP (MPa)	Flood	Salinity
T1	***flood only**	+	-
T2	**-1.6**	+	-
T3	**-2.0**	+	-
T4	**-1.6**	+	+
T5	**-2.0**	+	+
T6	**-1.6**	-	-
T7	**-2.0**	-	-
T8	**-1.6**	-	+
T9	**-2.0**	-	+
T10	****well watered**	-	-
T11	****well watered**	-	+

* Received only one flood of good quality water on May 1996

** Irrigated to Field Capacity twice a week

While the trees were small (during the first year), we used midday xylem leaf water potential for determining irrigation timing. Due to the large number of plots (33) and

the high frequency of measurements (2-3 times a week), it was not possible to schedule irrigation using mid-day LWP any more and we reversed to schedule irrigation using pre-dawn LWP.

On May 1996, treatments 1 to 5 were flooded and from then on, trees were irrigated with saline and fresh water, according to the treatments. The salinity of the water in the saline treatments was attained by mixing 3.5 kg of NaCl per 1 m^3 of water, and injecting the brackish solution into the main irrigation pipe, using a 2% to 10% proportional injection pump (Dosarton International, model DI-120, France).

In each plot, 16 trees were planted at a distance of 1 m between trees and 4 m between the rows of trees (Fig. 1).

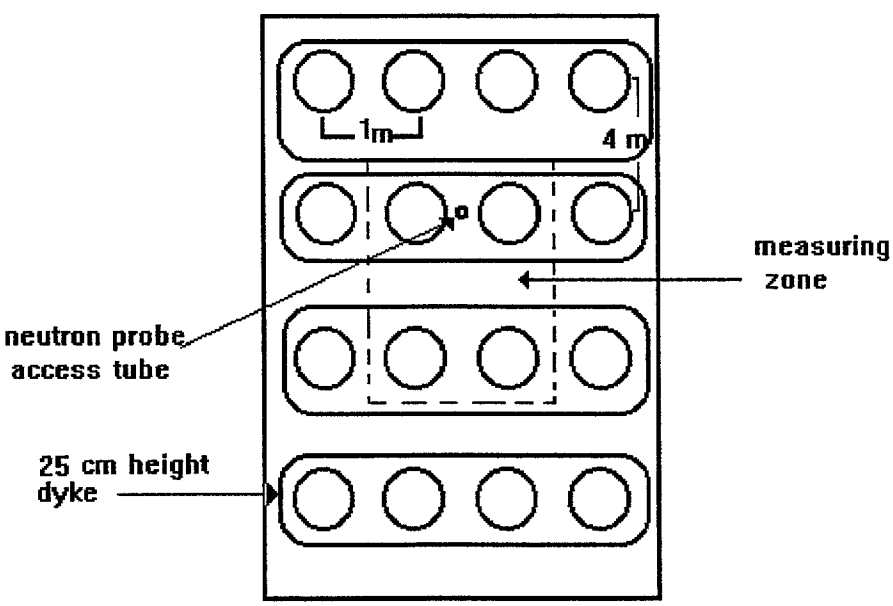

Fig. 1: Schematic description of a plot with 16 trees, the measuring zone and the neutron probe tube. All 33 plots of the experiment have the same description.

Measurements

In each plot an aluminum access tube was inserted at a distance of 0.5 m from a tree (Fig. 1), inserted to a depth of 2.4 m, for measuring soil water content using the neutron probe technique.

Pre-dawn water potential (Ψ_L) was measured using the Scholander pressure chamber (Ari II model, Arimad Kfar-Haruv, Israel) technique (Scholander et al., 1965). Five leaves from each treatment were carefully excised, immediately wrapped up in a plastic bag and stored in a sealed cool box with a wet rag (to prevent water loss from the leaves). Ψ_L was measured within 45 min. after excision. If the pre-dawn LWP reached its threshold value, soil water content was measured up to the maximum possible depth, using the neutron probe technique. Measurements were done in 15 cm intervals, to the depth of 1.2 m, and from that depth, up to the depth of 2.4 m, in 30 cm intervals.

Irrigation was applied through drip irrigation system. Each row of four trees was surrounded with a 25 cm height dyke (Fig 1). Four drippers of 4 l per h and four drippers of 24 l per h were used per basin. As a result of this design, the basin was flooded and the wall prevented excessive lateral movement and insured preferential vertical movement.

Trunk diameter was measured several times throughout the growing season, at a constant height of 0.2 m above soil surface, for estimating biomass production. Soil samples for the estimating electrical conductivity of the soil were obtained before and after flooding. The results are presently being processed. Saturated hydraulic conductivity of the upper layer was concurrently measured.

Results

Leaf water potential measurements

Pre-dawn leaf water potential measurements were carried out throughout the season (Fig. 2 A-E). Differences between treatments are not always large but irrigation was applied whenever the threshold Ψ_L was reached or exceeded.

Dates of irrigation in each of the treatments are presented in Table 2.

month	flood only	flood, fresh -1.6	flood, fresh -2.0	flood, saline -1.6	flood, saline -2.0	fresh -1.6	fresh -2.0	saline -1.6	saline -2.0	well water fresh	well water saline
May	+	+	+	+	+						
July		10	10	11	14	3	3	3	3	3	3
		16				10	10	11	15	10	11
		21	21	24	23	21	21	23	22	14	22
		28		29		28		29		15	29
										21	
										28	
August		5	1	6	1	5	1	6	1	5	1
		15	12	15	13	15	12	15	13	12	6
		19	22	22		22		22		15	13
		27		29	28		27		28	19	15
										22	19
										27	22
										29	26
											29
Sept.		4	4	5	5	4	4	5	5	4	5
		11	11	12		11		12		9	9
		25	25	20	20	25	19	26	20	11	12
		30	30	26		30	30			15	15
										19	20
										25	26
										30	
Oct.				1	1			1	1	6	1
		8		9	9	6				8	6
										13	9
			15				15			15	13

Table 2: Dates of irrigation in the various treatments, Sde-Boker, 1996.

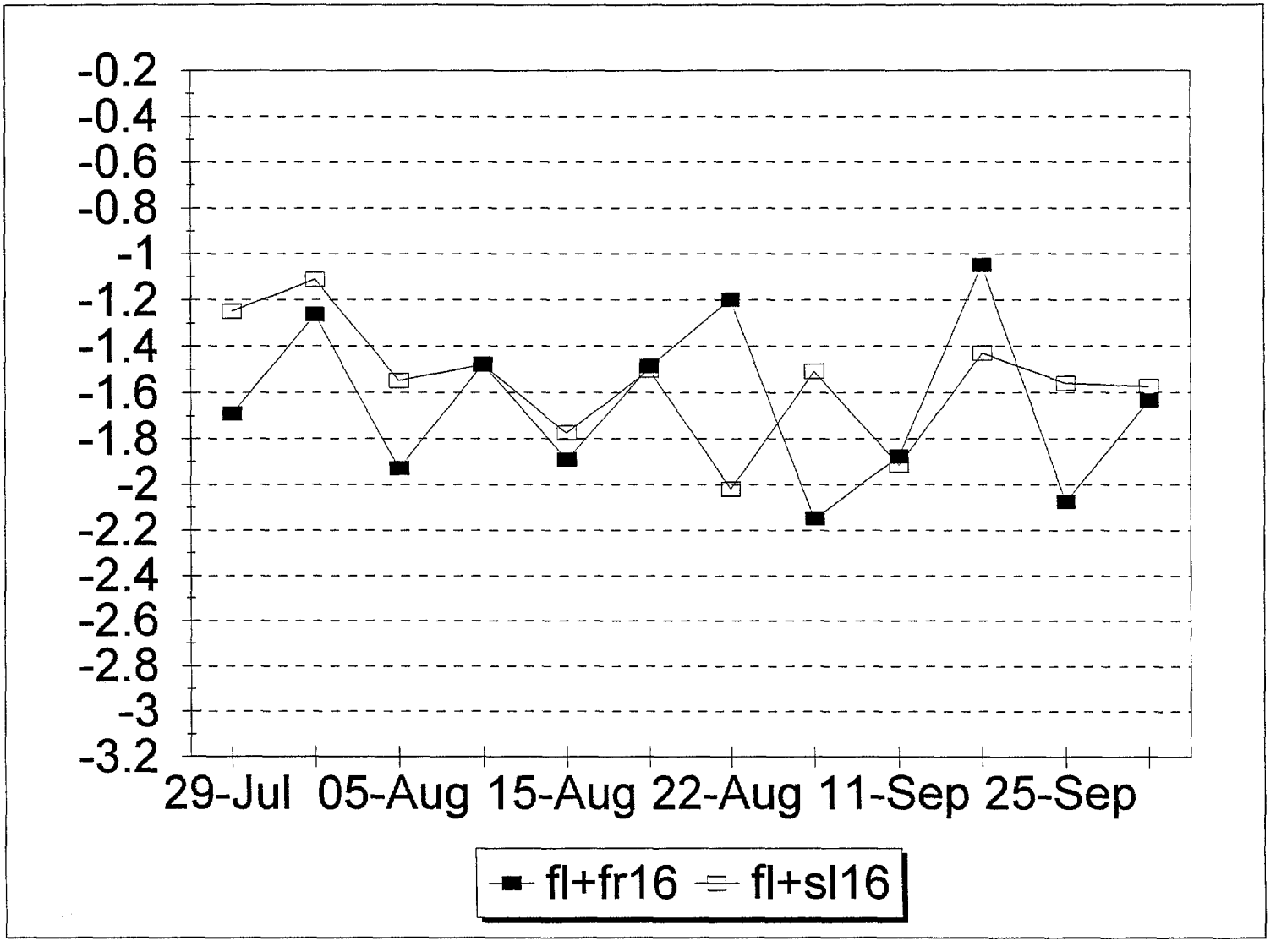

Fig 2A: Pre-dawan leaf water potential throughout the growing season in Treatments 2(flood, irrigation with fresh water at a LWP threshold of -1.6 Mpa) and Treatment 4(flood, irrigation with saline water at a LWP threshold of -1.6 Mpa)

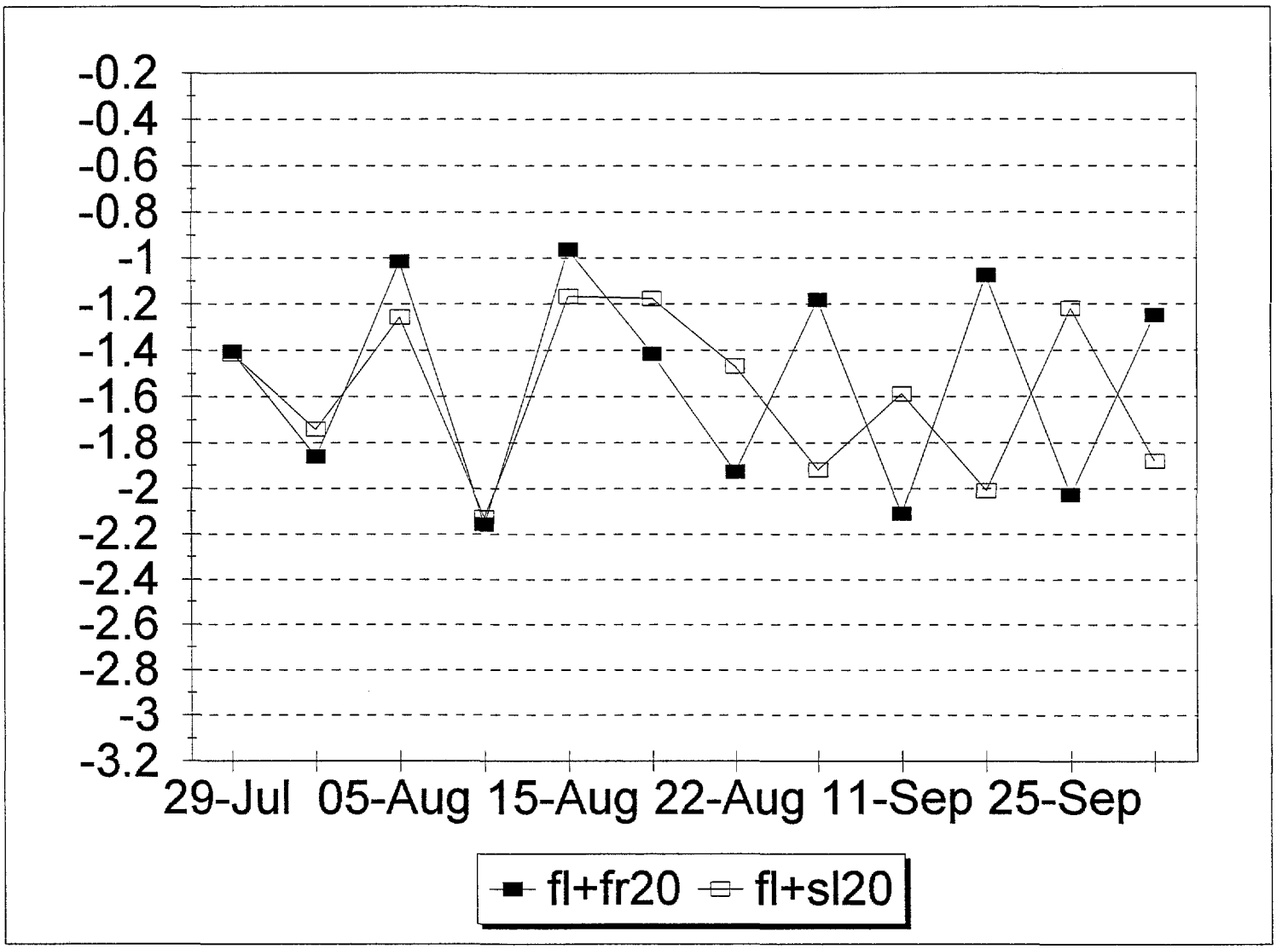

Fig. 2B: Pre-dawan leaf water potential throughout the growing season in Treatments 3 (flood, irrigation with fresh water at a LWP threshold of -2.0 Mpa) and Treatment 5 (flood, irrigation with saline water at a LWP threshold of -2.0 Mpa)

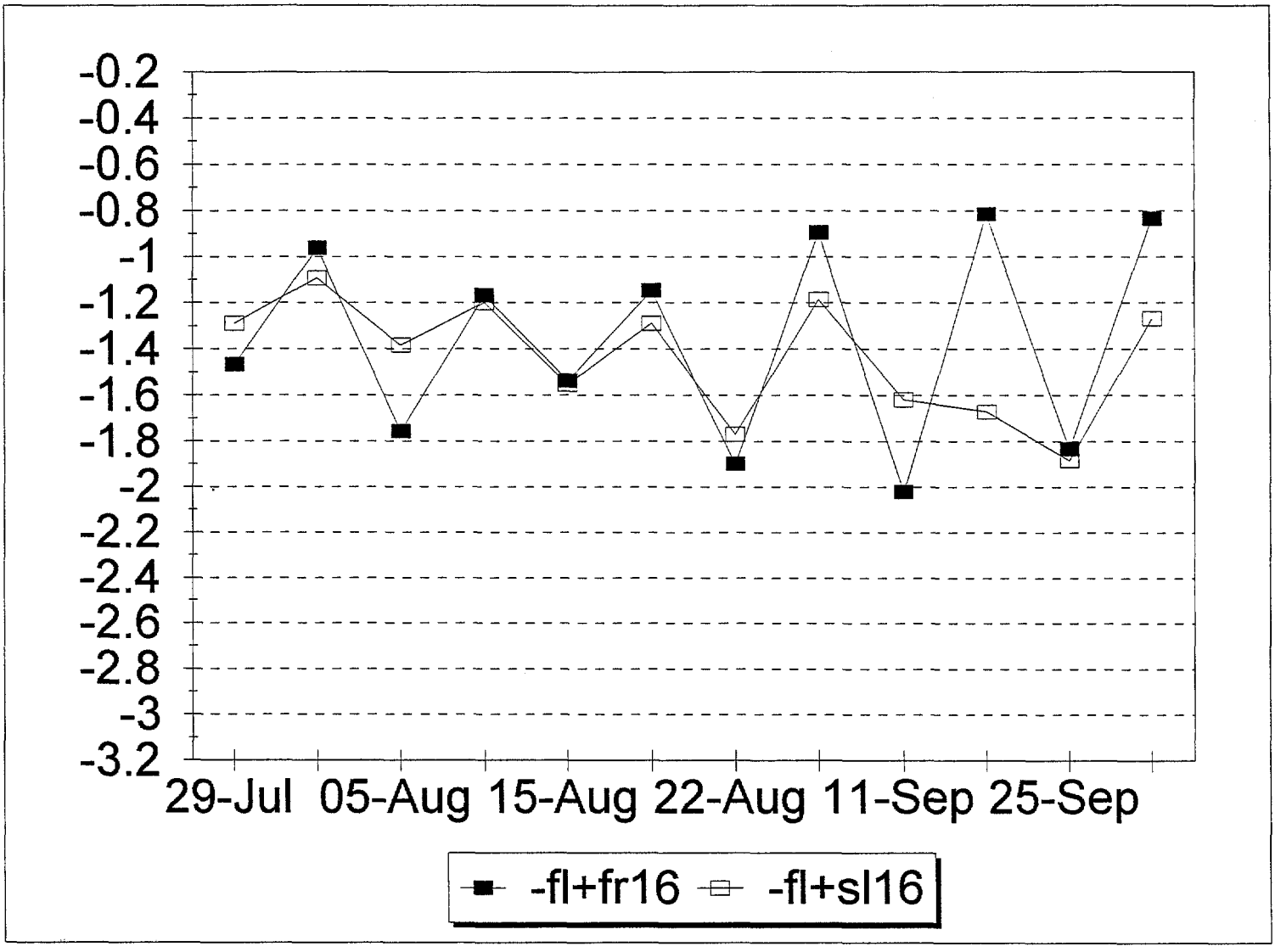

Fig. 2C: Pre-dawan leaf water potential throughout the growing season in Treatments 6 (irrigation with fresh water at a LWP threshold of -1.6 Mpa, without flood) and Treatment 8 (irrigation with saline water at a LWP threshold of -1.6 Mpa, without flood)

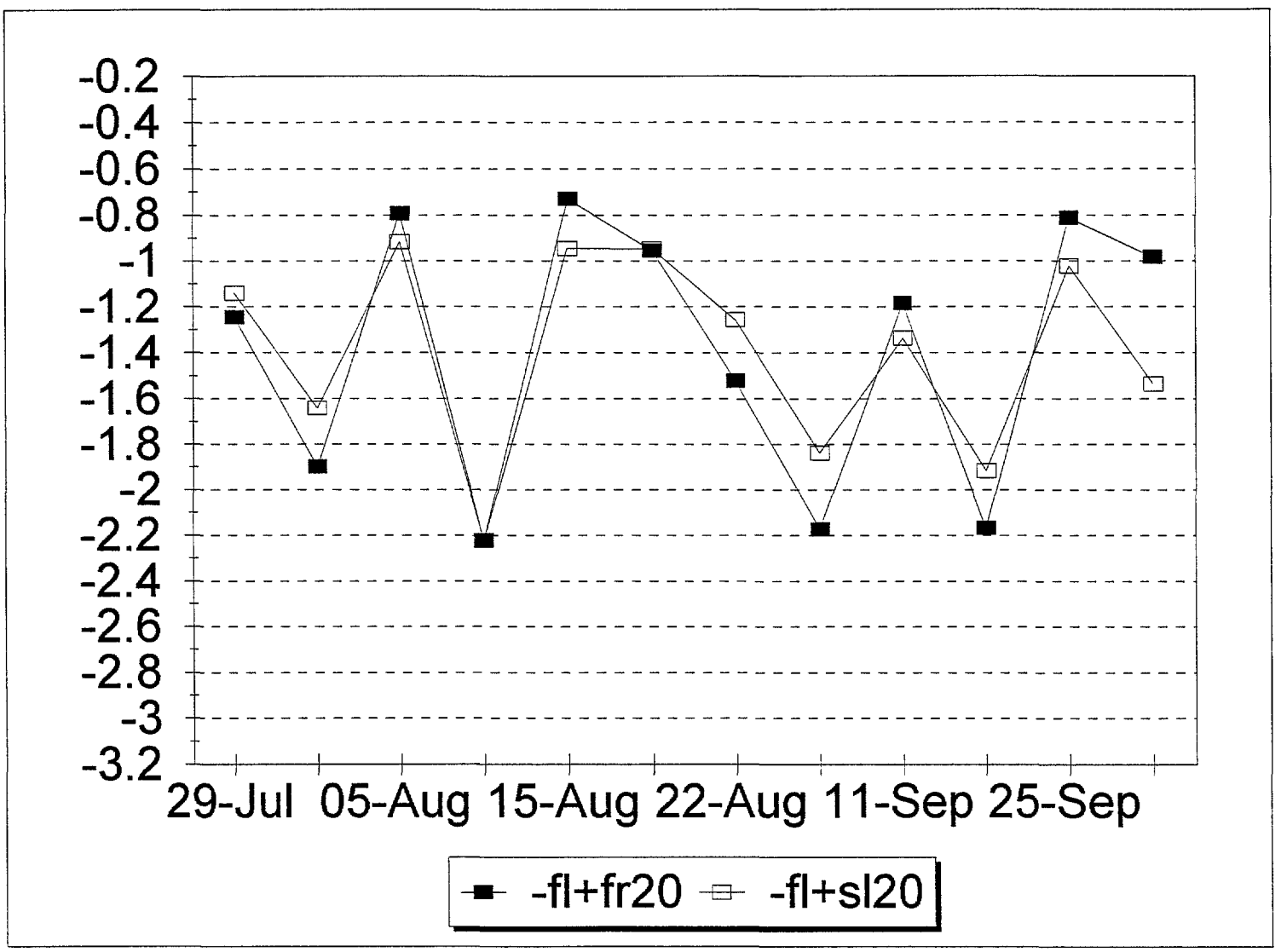

Fig. 2D: Pre-dawan leaf water potential throughout the growing season in Treatments 7 (irrigation with fresh water at a LWP threshold of -2.0 Mpa, without flood) and Treatment 9 (irrigation with saline water at a LWP threshold of -2.0 Mpa, without flood)

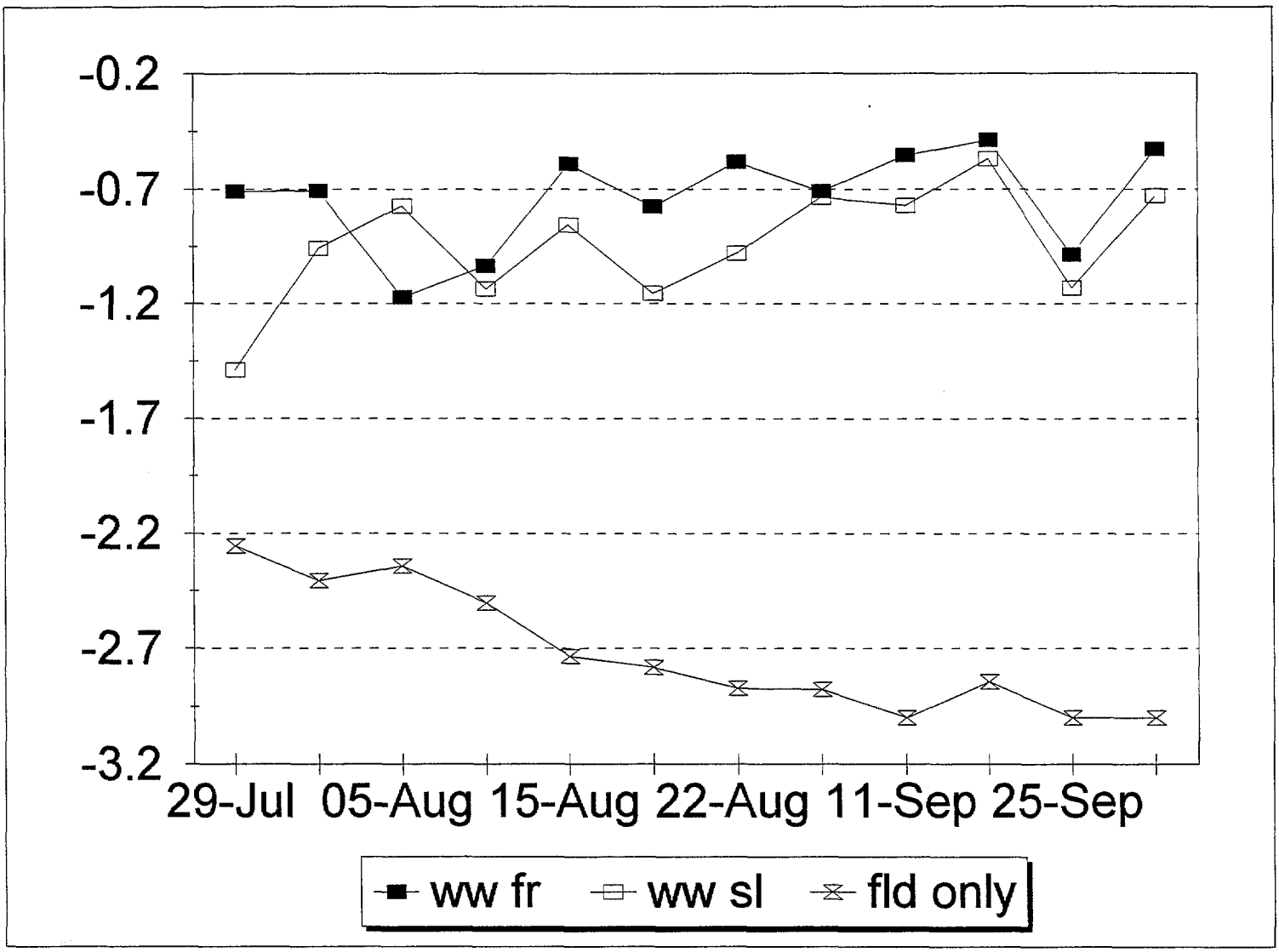

Fig.2E: Pre-dawan leaf water potential throughout the growing season in Treatments 1 (flood only) Treatment 10 (Well watered irrigation with fresh water) and Treatment 11 (Well watered irrigation with saline water)

Trunk diameter

In order to estimate biomass production, trunk diameter was measured, as allometric equations relating the square of trunk diameter to dry above ground biomass were statistically very significant. The increase in trunk diameter from the date of the flood at the beginning of the season (May 1996) until October 1996 was measured and compared between the various treatments (figs 3 A-E). In these graphs only thje averages per treatment are presented for clarity, as the statistical analysis has been performed seperately. The results indicate that there appear to be a statistically significant advantage to the saline treatments when compared to the treatments which were irrigated with fresh water as evident from the ANOVA results (Table 3).

Source of variation	Sum of squares	d.f.	Mean square	F-ratio	Sig. level
MAIN EFFECTS					
SALINITY	55.74	1	55.74	14.49	0.0017
FLOOD	197.89	1	197.89	51.467	0.0000
IRRIGATION LEVEL	0.84	1	0.84	.022	0.6503
INTERACTION					
SALINITY X FLOOD	18.08	1	18.08	4.70	0.0466
SALINITY X IRRIG. LEV	8.22	1	8.22	2.13	0.1643
FLOOD X IRRIG. LEV	2.19	1	2.19	0.57	0.4695
RESIDUAL	57.67	15	3.84		
TOTAL	369.52	21			

Table 3: Analysis of variance for trunk area and salinity, flood and irrigation level. The data presented here do not include treatment 1 (flood only), treatment 10 (well watered with fresh water) and treatment 11 (well watered with saline water).

Since the results obtained here are contradictory to the commonly accepted fact, that increasing the salinity level will cause a reduction in biomass production, a more detailed analysis aimed of finding out if there is any connection between the quality of

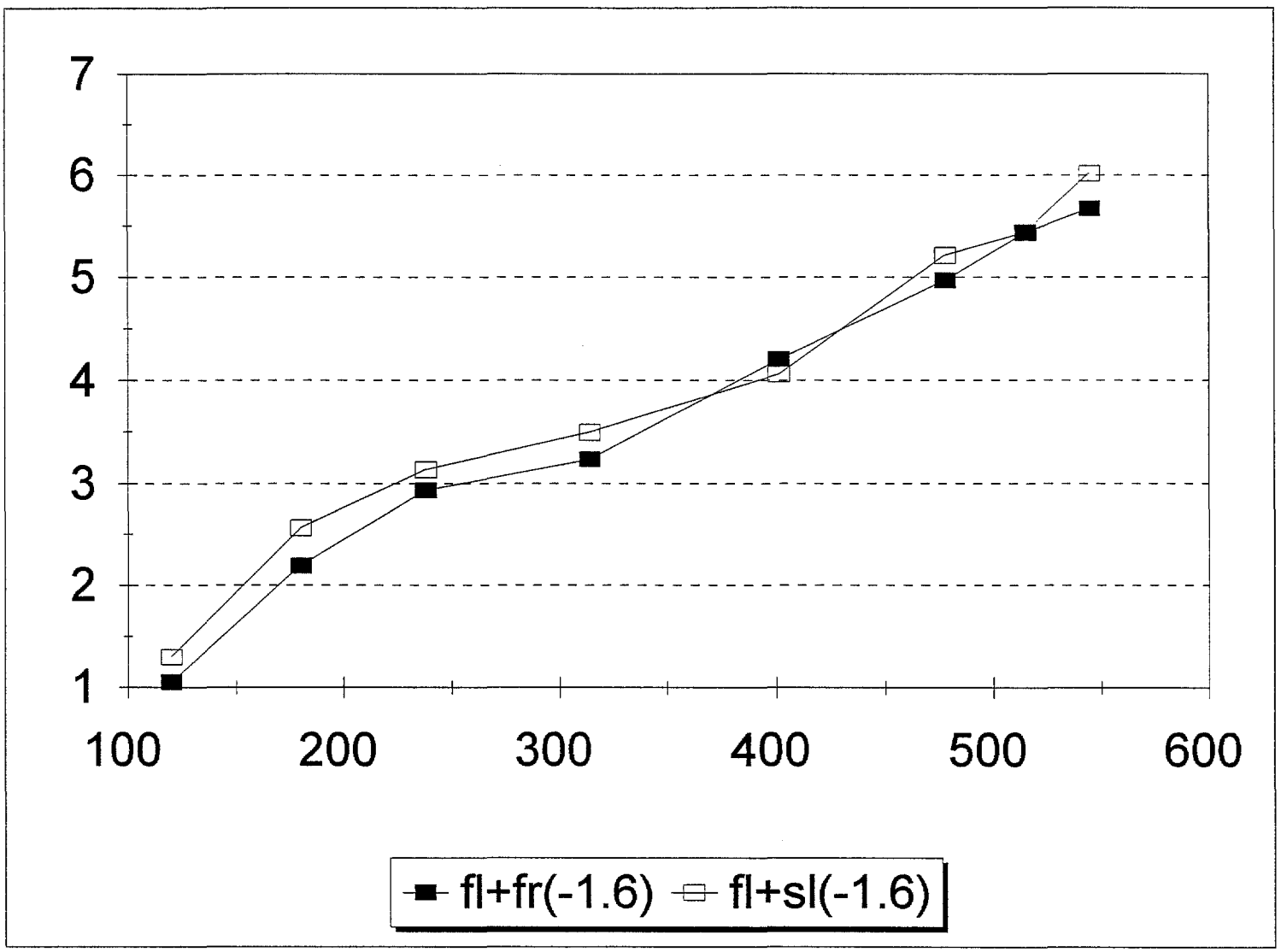

Fig 3 A: Trunk diameter development (in cm.) throughout the growing season in Treatments 2 (flood, irrigation with fresh water at a LWP threshold of -1.6 Mpa) and Treatment 4 (flood, irrigation with saline water at a LWP threshold of -1.6 Mpa)

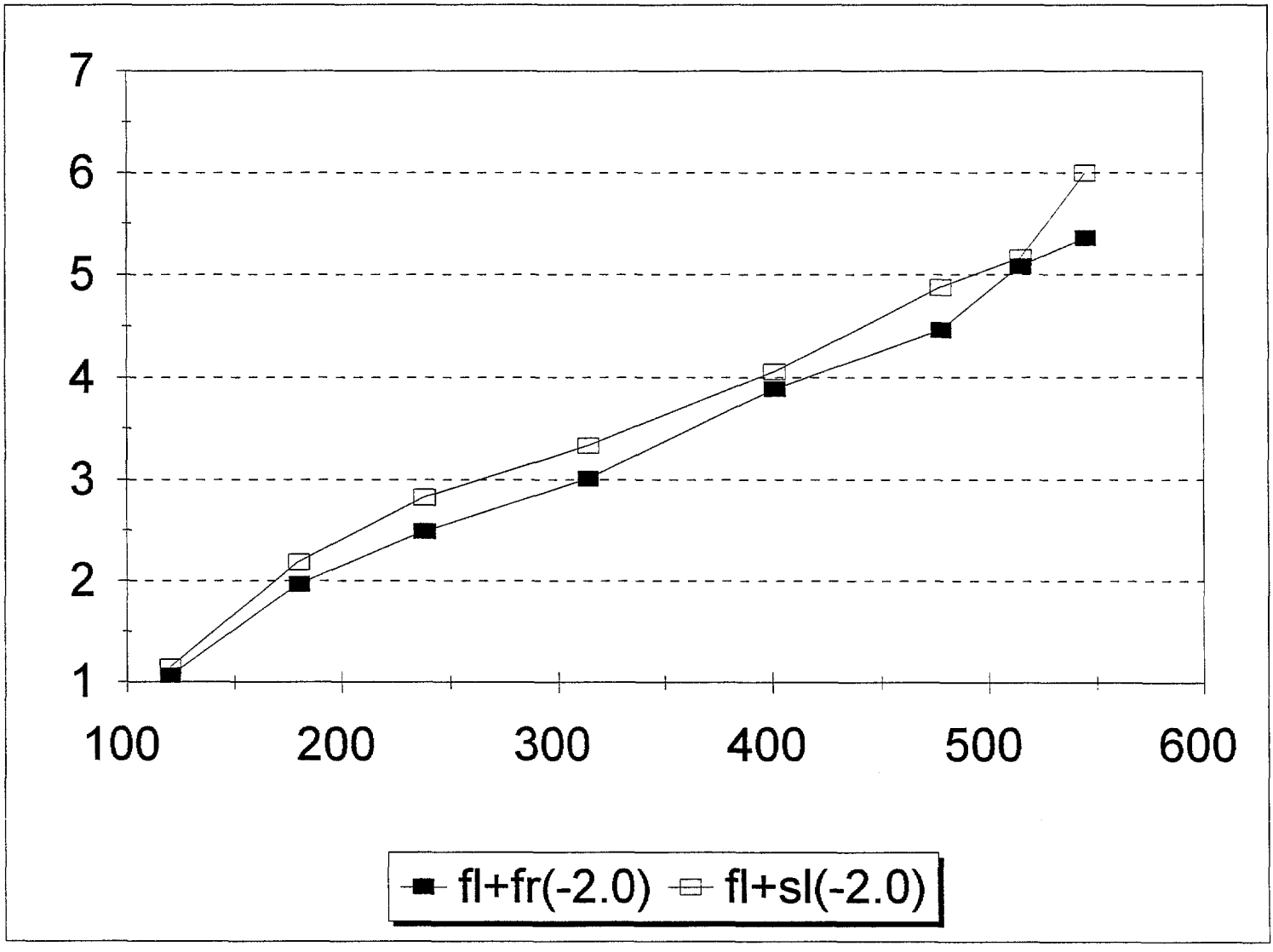

Fig 3B: Trunk diameter development (in cm.) throughout the growing season in Treatments 3 (flood, irrigation with fresh water at a LWP threshold of -2.0 Mpa) and Treatment 5 (flood, irrigation with saline water at a LWP threshold of -2.0 Mpa)

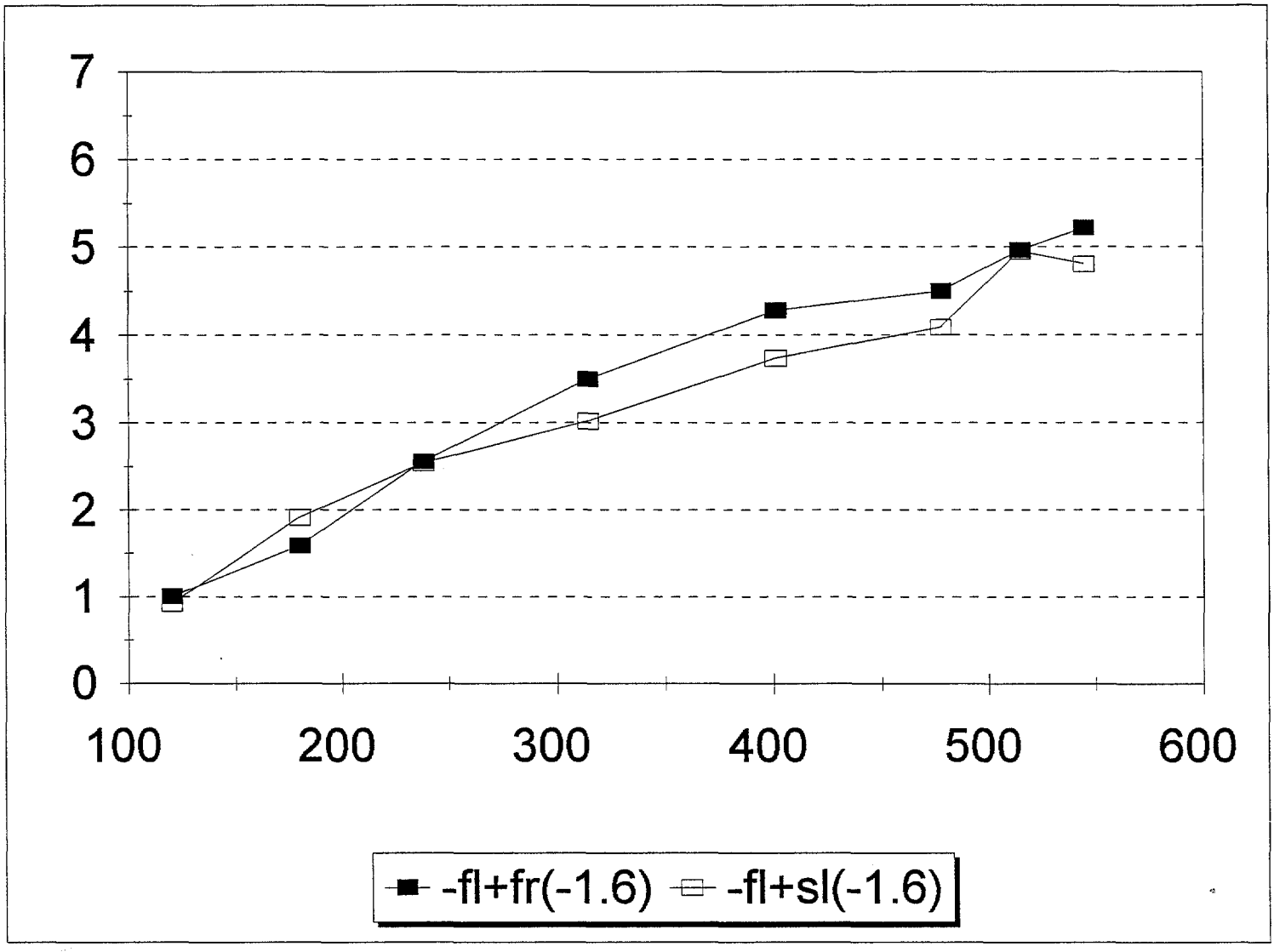

Fig. 3C: Trunk diameter development (in cm.) throughout the growing season in Treatments 6 (irrigation with fresh water at a LWP threshold of -1.6 Mpa) and Treatment 8 (irrigation with saline water at a LWP threshold of -1.6 Mpa)

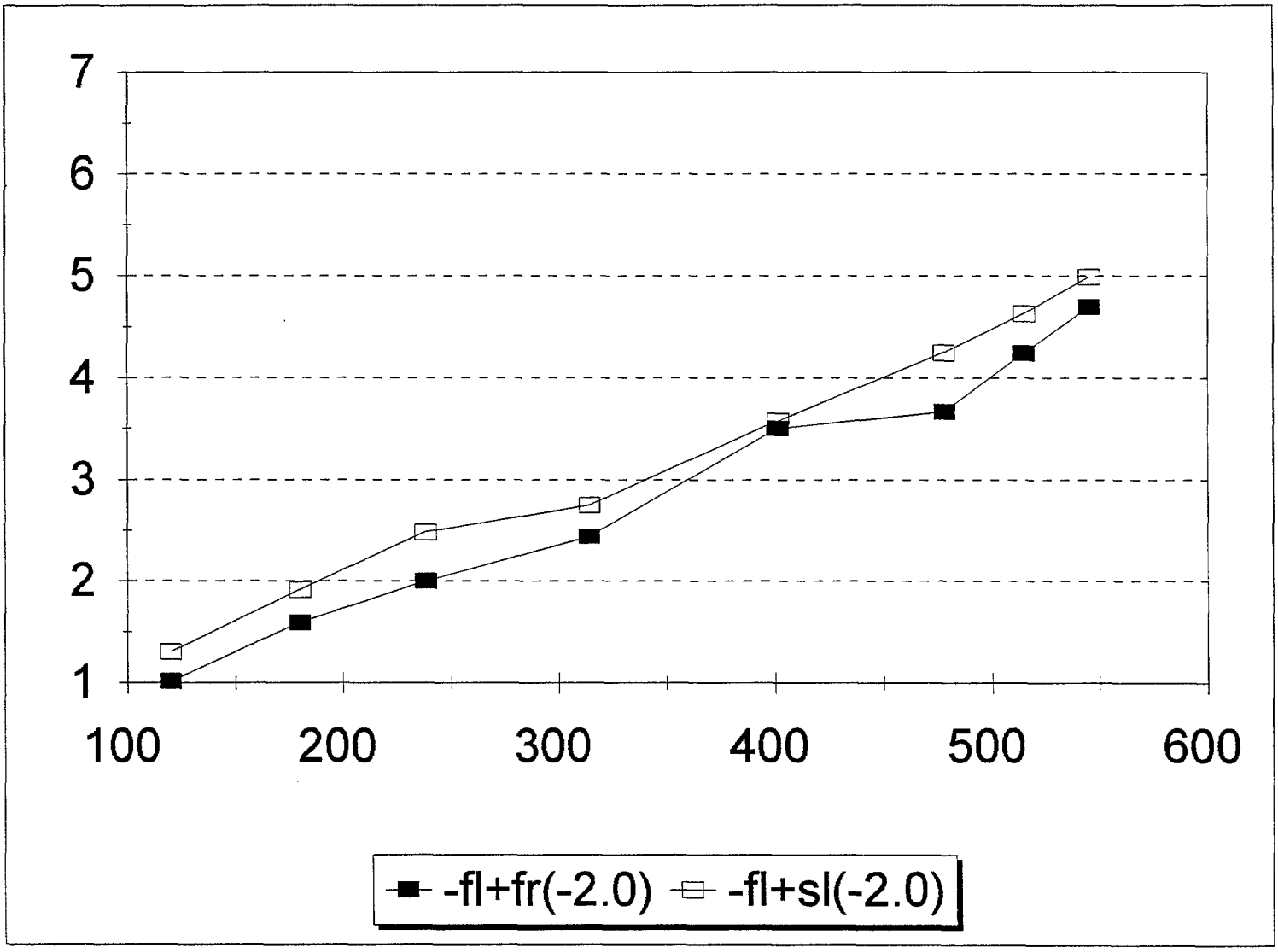

Fig 3D: Trunk diameter development (in cm.) throughout the growing season in Treatments 7 (irrigation with fresh water at a LWP threshold of -2.0 Mpa) and Treatment 9 (irrigation with saline water at a LWP threshold of -2.0 Mpa)

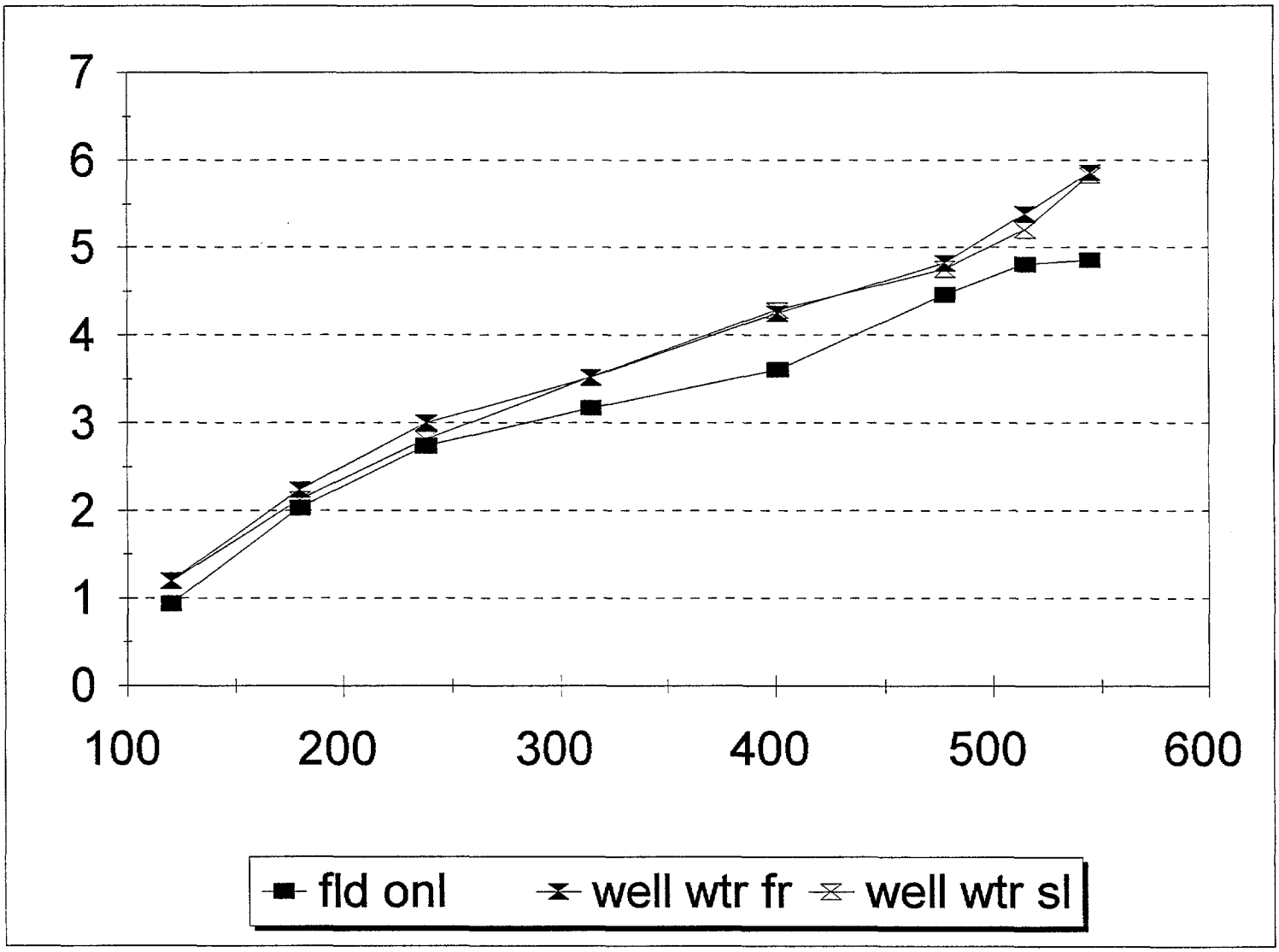

Fig 3E: Trunk diameter development throughout the growing season in Treatments 1 (flood only), Treatment 10 (Well watered irrigation with fresh water) and Treatment 11 (Well watered irrigation with saline water)

the water and the morphological and anatomical structure of the wood is necessary. Since these measurements are destructive, it would be preferable to start this study at the end of the measurement period.

KENYA

Heavy floods occurred during the period between September 95 and July 96 and the soil profile was completely wetted. The trees, which were planted in March, are developing well and the implementation of the differential irrigation treatments will start right after the coming flood. The trees are being monitor periodically for estimating biomass production. Results will be presented in our next report.