

SOUTH AFRICAN SUGAR INDUSTRY
AGRONOMISTS' ASSOCIATION

Code No : R100/90/R2
Cat No : 1744

Title: Soil moisture x Fusilade Super

1. Particulars of project

<p>This crop : 2nd ratoon Site : Pongola Field Station Blocks 308 and 309 Region : Northern area Soil system : Komatipoort Soil form/series: Shorrocks Design : Randomised blocks Plot size : 6 rows x 1,2m x 1,5m Variety : NCo376 Date and age at spraying : 18.4.90 (8,7 months) Date and age at harvest : 25.7.90 (12,0 months) Sampling dates : 24/4; 15/5; 12/6; 25/7 Days after spraying : 2, 26, 54, 96 Irrigation : See treatments Rainfall : See moisture balance</p>	<p>Spray method: CO₂ operated knapsack and lance with 2 TK 1,0 floodjets Pressure: 1,75 kPa Volume/ha: 77 l Weather at spraying: Sunny and warm. Temp. 20°C (8 am), RH 85% Condition of cane at spraying: W1 plots:9,7 green leaves per stalk W4 plots:8,7 green leaves per stalk Purity: W1 and W2 = 80% W3 and W4 = 83% Sampling technique: 4 stalks taken from 4 predetermined points of centre 2 net rows. Starting point advanced by 1m on each sampling occasion. Pre and post harvest sample taken from one outer net row. Samples for sectioning taken from the other outer net row. (24 stalks/plot)</p>
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2. Objectives:

1. To assess the effects of various levels of soil moisture on the response to Fusilade Super.
2. To observe the residual effects of Fusilade Super used on sugarcane subjected to moisture stress.
3. To study the changes in sucrose, glucose and fructose in sections of the stalk due to ripening.

3. Treatments:

<u>1. Control</u>	<u>Ripener</u>	<u>Drying off</u>
1. CW1	2. RW1	Nil
3. CW2	4. RW2	Moderate
5. CW3	6. RW3	Interrupted
7. CW4	8. RW4	Severe

Notes on treatments

All plots were irrigated equally upto October (61 mm x 3 + 50 mm = 233 mm). After September Perf-o-rain pipes were used to irrigate plots individually so that W4 plots received no further irrigation after October while W1 plots received 250 mm, W2 plots received 100 mm (50 mm in February and 50 mm in March) and W3 plots received 100 mm (50 mm in June and 50 mm in July).

Treatments were re-randomised for this crop.

Moisture balance

Month (from 25 July 1989)	Moisture received		Moisture lost (Et) mm				Accumulated moisture rainfall + irrigation - Et			
	Rainfall (mm)	Irrigation (mm)					All plots			
July	0	0					- 9			
Aug	12,8	61					+ 6,3			
Sept	7,3	122					+32,1			
Oct	83,3	50					+31,0			
			W1	W2	W3	W4	W1	W2	W3	W4
Nov	384,5		-	-	-	-	+263,6	+263,6	+263,6	+263,6
Dec	128,9		-	-	-	-	+187,3	+187,3	+187,3	+187,3
Jan	55,0		-	-	-	-	+ 39,8	+ 39,8	+ 39,8	+ 39,8
Feb	76,6		-	50	-	-	- 36,7	+ 13,3	- 36,7	- 36,7
Mar	54,7		50	50	-	-	- 79,7	- 29,7	-129,7	-129,7
Apr	55,5		50	-	-	-	- 83,3	- 83,3	-183,3	-183,3
May	3,0		50	-	-	-	-119,3	-169,3	-269,3	-269,3
June	0		50	-	50	-	-165,3	-265,3	-315,3	-365,3
Jul	2,6		50	-	50	-	-177,2	-327,2	-327,2	-427,2
Totals	864,2		483	333	333	233				

Ripener: Fusilade Super was sprayed at 330 ml/ha on 18 April 1990 when the crop was 8,7 months old.

Procedure of sectioning stalks

- ° On the day prior to applying the ripener the length of the sheaths of the upper most leaves with visible collars were measured on 15 stalks from W1 plots (\bar{x} = 269 mm) and W4 plots (\bar{x} = 252 mm). Using a mean of 260 mm for sheath length a mark was painted on stalks 860 mm below the upper most visible collar in W1 and W4 plots.
- ° Twenty four stalks/plot (W1 and W4 plots) were sectioned on 19 April, 8 June and 10 July in the following manner:
 - Section 3 - 20 cm length above mark on stalk
 - Section 2 - 20 cm length above section 3
 - Section 1 - top most section above section 2
 - Section 5 - 1 m length measured from the base
 - Section 4 - remaining section of variable length.

- ° Each section was processed and analysed separately.

Juice from each section was clarified and frozen in sealed sachets for sucrose, glucose and fructose analysis at a later date.

Leaf Water Potential (W1) readings

Readings were taken on 28 March, 21 April, 11 July and 24 July. Moisture balances indicate that during March differences between W1 and W4 started to develop.

Plant Extension Rate

Measurements were recorded between 29 March and 17 April.

Other Measurements

- ° At harvesting tops left in each plot were collected, weighed and samples were analysed for sucrose content.
- ° 60 stalks from W3 and W4 were sectioned (305 mm lengths) at harvest to compare the sucrose distribution in stalks subjected to these two treatments (W4 = stressed; W3 = stress relieved).

4. Results

4.1

Treatment	Lodging (% rated)	Flowers emerged %
	25 July	25 July
CW1	9	41,0
RW1	11	6,1
CW2	7	30,3
RW2	19	4,4
CW3	9	6,7
RW3	4	0,7
CW4	3	6,1
RW4	3	0,0
Mean	8,1	11,9

4.2 Numbers of green leaves per stalk

Treatment	20 April	8 June	17 July
CW1	9,7	8,6	8,8
RW1		8,2	6,6
CW4	8,7	6,7	6,4
RW4		6,9	5,6
Mean	9,2	7,6	6,9

4.3 Sample data

4.3.1 Changes in quality of unsprayed plots

Date and (DAT)	ers % cane			
	20/4 (2)	15/5 (26)	11/6 (54)	24/7 (96)
<u>Treatments</u>				
W1	5,9	9,0	10,0	12,3
W2	5,9	8,6	9,4	12,6
W3	7,9	10,5	11,3	13,5
W4	7,7	10,8	11,0	13,7
MEAN	6,9	9,7	10,4	13,0

4.3.2 Responses to Fusilade Super (ers % c)

Treatment	Date (DAT)	15/5 (26)	11/6 (54)	24/7 (96)
W1	-	-0,2	-1,2	-0,6
W2	-	+0,4	+1,3	-0,3
W3	-	+0,7	+0,9	+0,3
W4	-	+0,7	+0,3	+0,2
MEAN		+0,4	+0,9	-0,1
CV %		9,7	12,1	9,3
SED ±		0,51	0,7	0,65
LSD (P=0,05)		1,0	1,4	1,31

4.3.3 Changes in stalk mass of unsprayed cane

Date and (DAT)	20/4 (2)	15/5 (26)	11/6 (54)	24/7 (96)
<u>Treatments</u>				
W1	1077	1002	1028	1017
W2	953	959	1007	975
W3	924	910	951	952
W4	940	879	882	942
MEAN	974	938	967	972

4.3.4 Effects of Fusilade Super on stalk mass (Ripened-Control)

W1	- 33	+101	-18	+ 8
W2	+102	- 20	- 6	+67
W3	+163	- 12	-72	-38
W4	- 42	- 54	+25	-11
MEAN	+48	+ 15	-18	+ 7
CV %	16,0	12,9	11,5	13,0
SED	84,8	64,6	59,1	68,0
LSD(P=0,05)	171,0	130,3	119,3	137,1

4.3.5 Responses to Fusilade Super (Ripened-Control)

Date and (DAT) Treatment	ers g/ stalk		
	15/5 (26)	11/6 (54)	24/7 (96)
W1	+6,7	+10,8	-4,5
W2	+1,6	+12,4	+4,4
W3	+4,3	- 0,5	-3,1
W4	+0,9	+ 5,0	+2,3
MEAN			
CV %	15,4	16,7	14,9
SED ±	7,6	9,3	10,0
LSD (P=0,05)	15,4	18,7	20,2

4.4 Harvest data (96 DAT)

Treatments	t cane/ha	ers % c	t ers/ha	Purity %	Stalk	
					Height (cm)	pop. x1000/ha
CW1	140,8	11,8	16,6	86,2	250	153
RW1	124,9	12,0	15,1	85,8	239	128
CW2	124,2	12,1	15,0	84,9	245	143
RW2	127,5	11,5	14,6	82,3	240	121
CW3	123,3	13,3	16,3	87,6	230	169
RW3	109,5	13,2	14,4	85,8	223	135
CW4	105,8	13,1	13,9	83,7	229	126
RW4	98,9	13,8	13,7	85,5	227	136
MEAN	119,4	12,6	14,9	85,2	235	139
CV %	13,1	6,8	16,0	2,3	5,5	12,0
SED ±	8,35	0,5	1,3	1,1	6,9	8,9
LSD (P=0,05)	16,8	1,1	2,6	2,2	13,9	17,9
LSD (P=0,01)	22,5	1,4	3,4	2,9	18,6	24,0
IRRIGATION MEANS						
W1	132,8	11,9	15,8	86,0	245	140
W2	125,9	11,8	14,8	83,6	242	132
W3	116,4	13,3	15,4	86,7	227	152
W4	102,3	13,4	13,8	84,6	228	131
SED ±	5,9	0,38	0,90	0,76	4,9	6,3
LSD (P=0,05)	11,9	0,77	1,82	1,53	9,89	12,7
LSD (P=0,01)	15,9	1,03	2,44	2,04	13,2	17,0
RIPENER MEANS						
Control	123,5	12,6	15,5	85,6	238	148
Fusilade Super	115,2	12,6	14,4	84,8	232	130
SED ±	4,17	0,27	0,64	0,53	3,44	4,45
LSD (P=0,05)	8,4	0,54	1,29	1,08	6,94	8,98

4.5 Comparison of pre harvest and post harvest samples

Treatments	Fresh mass g/stalk		Pol % C		Sucrose g/stalk	
	Pre	Post	Pre	Post	Pre	Post
CW1	1017	1100	13,9	13,5	141,3	148,2
RW1	1025	1087	13,5	13,8	138,1	149,5
CW2	975	1010	14,5	14,0	141,5	141,1
RW2	1042	929	14,2	13,5	147,4	126,4
CW3	952	950	15,2	15,0	145,3	142,0
RW3	914	941	15,5	15,1	142,0	141,4
CW4	942	878	15,6	15,3	146,5	133,8
RW4	931	921	15,8	15,7	146,9	144,7
MEAN	975	977	14,8	14,5	143,6	140,9
CV %	13,0	9,7	7,7	6,8	14,3	10,9
SED ±	67,9	50,6	0,61	0,52	11,0	8,2
LSD (P=0,05)	137,1	102,0	1,20	1,06	22,1	16,6
<u>IRRIGATION MEANS</u>						
W1	1021	1094	13,7	13,6	139,7	148,9
W2	1009	969	14,4	13,7	144,4	133,8
W3	933	945	15,4	15,0	143,7	141,7
W4	937	899	15,7	15,5	146,7	139,3
SED ±	48,1	35,7	0,43	0,37	7,7	5,8
LSD (P=0,05)	96,9	72,1	0,86	0,75	15,6	11,8
<u>RIPENER MEANS</u>						
Control	972	984	14,8	14,4	143,6	141,3
Fusilade Super	978	969	14,7	14,5	143,6	140,5
SED ±	34,0	25,3	0,30	0,53	5,5	4,1
LSD (P=0,05)	68,6	51,0	0,61	0,71	11,1	8,3

4.6 Analysis of tops left after harvesting

Treatments	Fresh mass g/top	Pol % C	Sucrose g/top	ers g/top
CW1	116	6,8	7,9	4,9
RW1	113	8,0	9,1	6,4
CW2	86	7,0	6,0	3,6
RW2	114	8,5	9,7	6,8
CW3	85	6,5	5,5	3,3
RW3	79	6,9	5,2	3,6
CW4	72	7,7	5,3	3,5
RW4	64	7,7	4,9	3,1
MEAN	91	7,4	6,7	4,4
CV %	21,5	14,7	31,5	40,0
SED ±	10,5	0,58	1,2	0,94
LSD (P=0,05)	21,1	1,2	2,3	1,9
<u>IRRIGATION MEANS</u>				
W1	114	7,4	8,6	5,7
W2	100	7,7	7,9	5,2
W3	82	6,7	5,6	3,5
W4	68	7,7	5,3	3,3
SED ±	7,4	0,41	0,81	0,67
LSD (P=0,05)	14,9	0,83	1,65	1,35
<u>RIPENER MEANS</u>				
Control	90	7,0	6,3	3,8
Fusilade Super	93	7,8	7,4	5,0
SED ±	5,2	0,29	0,58	0,47
LSD (P=0,05)	10,6	0,59	1,16	0,95

4.7 Analysis of untreated W3 an W4 stalks by sections

Stalk section	Fresh mass g/section		Pol % c		Pol % dm	
	CW3	CW4	CW3	CW4	CW3	CW4
Seg.7 (base)	180	164	16,6	17,1	52,7	51,7
Seg.6	164	154	16,1	16,1	52,9	51,7
Seg.5	148	142	15,9	15,4	53,4	51,0
Seg.4	143	124	15,8	15,2	54,9	48,4
Seg.3	128	126	15,5	15,1	54,7	51,2
Seg.2	116	104	13,6	13,8	51,2	49,2
Seg.1	88	67	11,6	14,1	44,0	49,6
"Tops"	85	72	6,5	7,7	23,9	26,5

- 4.8 Partitioning data: Changes in sucrose content (figures 1a and 1b), stalk mass (fig. 2) and sucrose mass (fig. 3) of various stalk sections are shown for W1 and W4 cane with and without ripener treatments.
- 4.9 Leaf water potential (ψ_l): ψ_l for various treatments are shown in figures 4 and 5 on occasions between 28 March and 24 July. Fig. 6 shows mean values.
- 4.10 Plant extension rates (PER): Measurements done between 29 March and 17 April are shown in figure 8.

5. General Comments

5.1 Lodging, flowers and green leaf number

- ° Flower emergence was significantly lower in W3 and W4 plots. Few flowers were counted in plots sprayed with Fusilade Super.
- ° While lodging was less severe than in the previous crop cane in only 4 replications was suitable for taking the final partitioning samples.
- ° Green leaf numbers were reduced by about 2,5 leaves per stalk by 11 July in W4 plots. Fusilade Super reduced the number of green leaves by 1 per stalk in W1 and W4 plots.

5.2 Sample data

- ° Quality of W3 and W4 cane was substantially higher than that of W1 and W2 cane when Fusilade Super was applied in April. Although the differences between W1 and W2 and W3 and W4 were smaller in July they were still significant ($P=0,05$).
- ° Cane mass measurements of W4 plots were consistently ($P=0,05$) lower than W1 cane with the exception of last sampling occasion.
- ° Responses to Fusilade Super were most evident 54 days after application in W1 and W2 treated cane. The small improvements in quality of W3 and W4 cane 26 days after spraying did not translate into sucrose yield benefits.

5.3 Harvest data

- ° Sample data indicated the time interval of 96 days after spraying Fusilade Super was too long to gain any benefit from applying the ripener.
- ° Cane yields were significantly lower ($P=0,05$) in Fusilade Super treated plots and since there was no indication that individual stalk mass was reduced the yield reduction must be due to the population differences recorded. Fusilade Super had no effect on cane quality at the time of harvesting.

- ° The most severe drying off treatment (W4) reduced cane yields by $30 \pm 5,9$ t/ha. Sucrose yields were reduced by $2 \pm 0,9$ t/ha not withstanding the improved quality of 1,5 ers units.
- ° Cane which was subjected to similar stress as in W4 but was irrigated twice before harvesting (W3) produced $14 \pm 5,9$ t cane/ha and $1,6 \pm 0,9$ t ers/ha more than W4 cane. The sucrose yields of W3 cane were similar to W1 cane despite W1 cane yields being $16,4$ t/ha higher than W3 cane. Plots subjected to mild stress (W2) yielded $1,0$ t ers/ha less than W1 plots.

5.4 Pre and post harvest samples and tops

Cane stalks taken before harvesting (of which tops were broken off by hand) yielded similarly to stalks which were taken from harvested cane (topped with cane knives), regardless of whether ripener had or had not been applied.

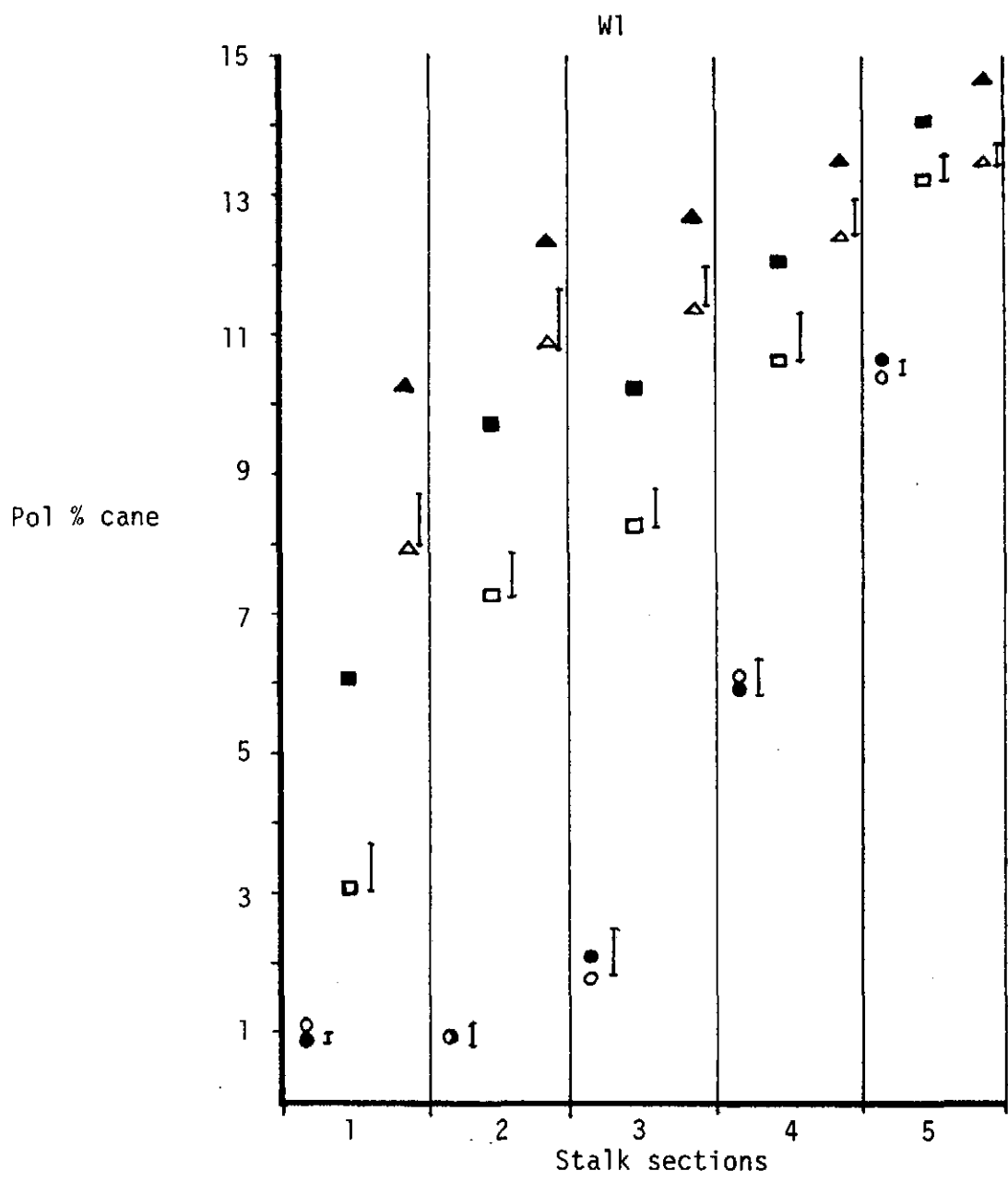
5.5 Stressed vs stress relieved (W4 vs W3)

The results provide no evidence of sucrose having been mobilised from the base of the stalk to support growth process at the stalk apex when stress is relieved.

5.6 Partitioning data (figures 1a, 1b, 2 and 3)

- ° Differences in sucrose content between cane sprayed with Fusilade Super and unsprayed cane were clearly greater in W1 cane than in W4 cane and were most evident in the sample taken on 8 June (50 days after spraying). Within W1 stalk sections differences in sucrose content between sprayed and unsprayed diminished from the top to the base. Although these differences were smaller in sections 4 and 5 (base 1 m) they were clearly real in W1 cane but not in W4 cane.
- ° There is no clear evidence that Fusilade Super had any effects on the mass of any section of the stalk.
- ° The sucrose yield response of $2,2$ g pol ($P=0,05$) from sections 1 and 2 in W1 cane sectioned 50 days after spraying was appreciably smaller than the $5,7$ g pol (ns) from section 5.

FIGURE: 1a EFFECT OF TREATMENTS ON SUCROSE CONTENT



Date 19/4 8/6 10/7
 DAT. -5 50 81
 CW = ○ □ △
 RW = ● ■ ▲

] Bars denote Se.D.

FIGURE: 1b EFFECT OF TREATMENTS ON SUCROSE CONTENT

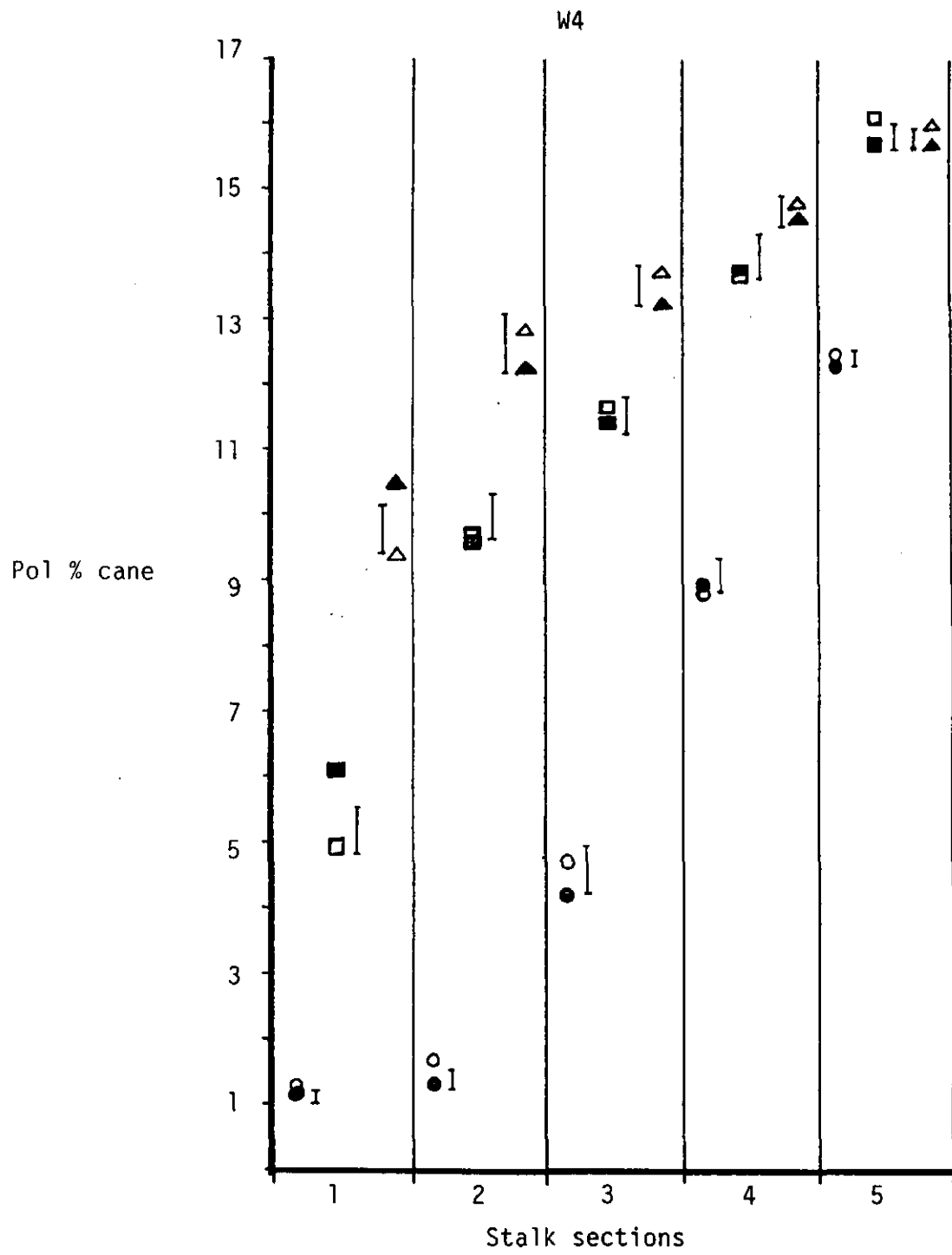
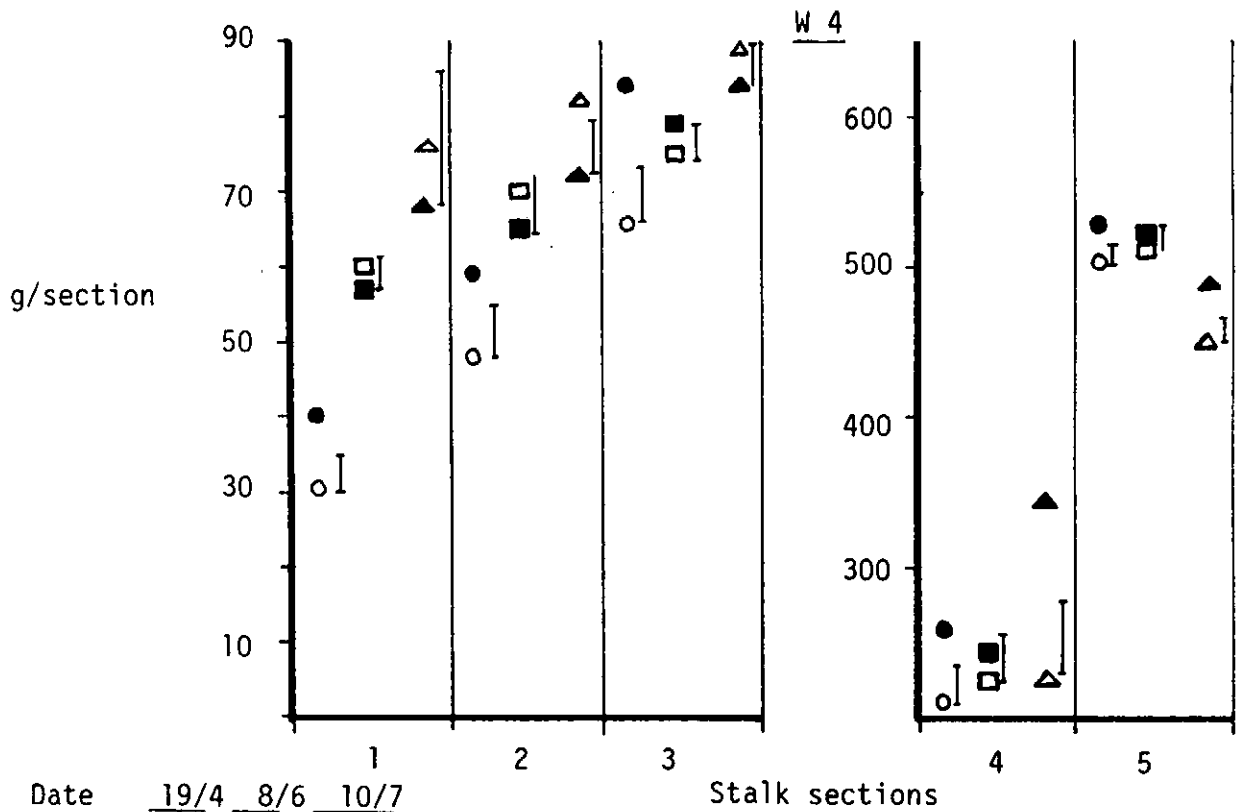
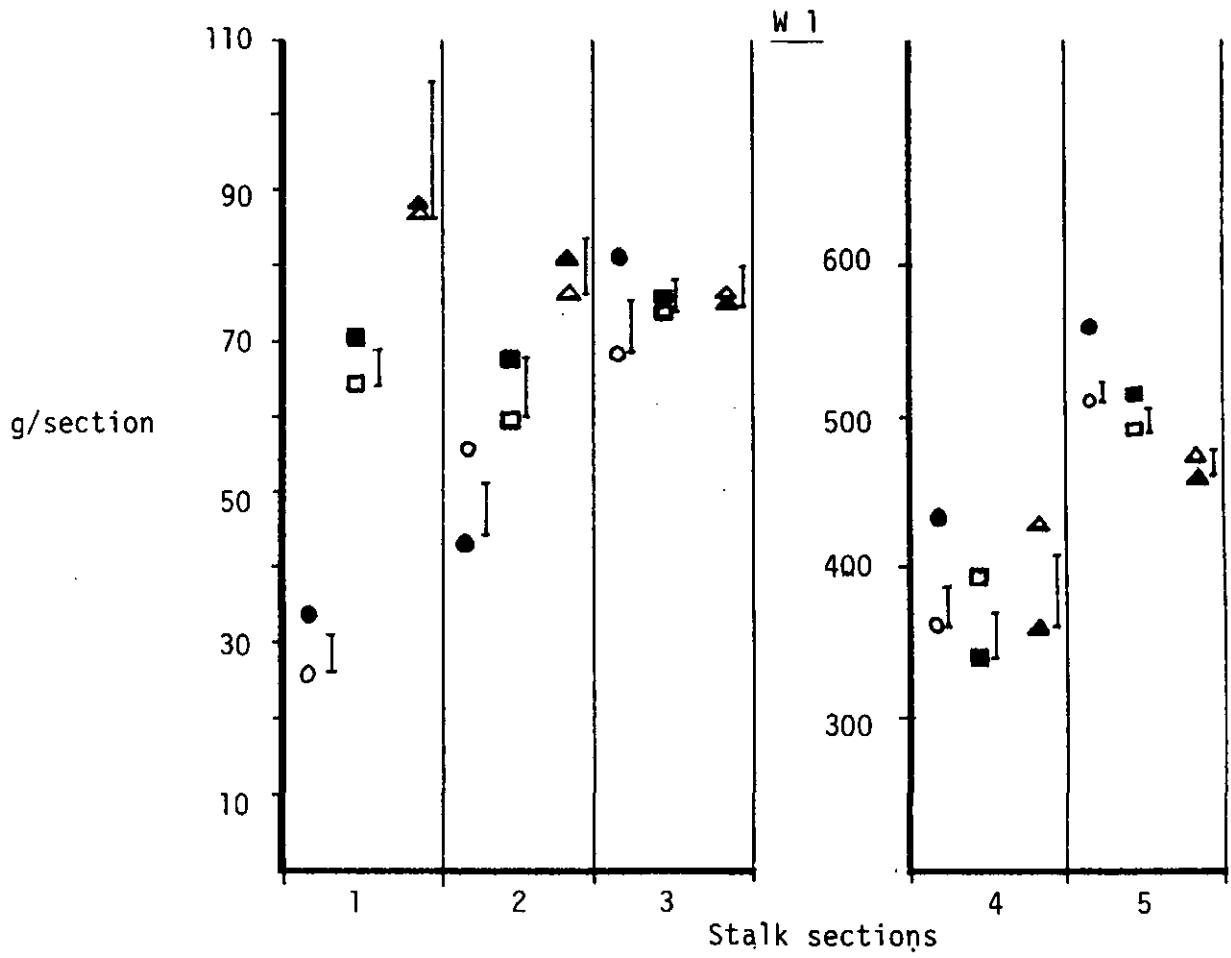


FIGURE: 2 EFFECTS OF TREATMENTS ON CANE FRESH MASS (g/section)



Date 19/4 8/6 10/7

CW = ○ □ △
 RW = ● ■ ▲

Bar denotes SE.D.

FIGURE: 3a EFFECT OF TREATMENTS ON SUCROSE MASS

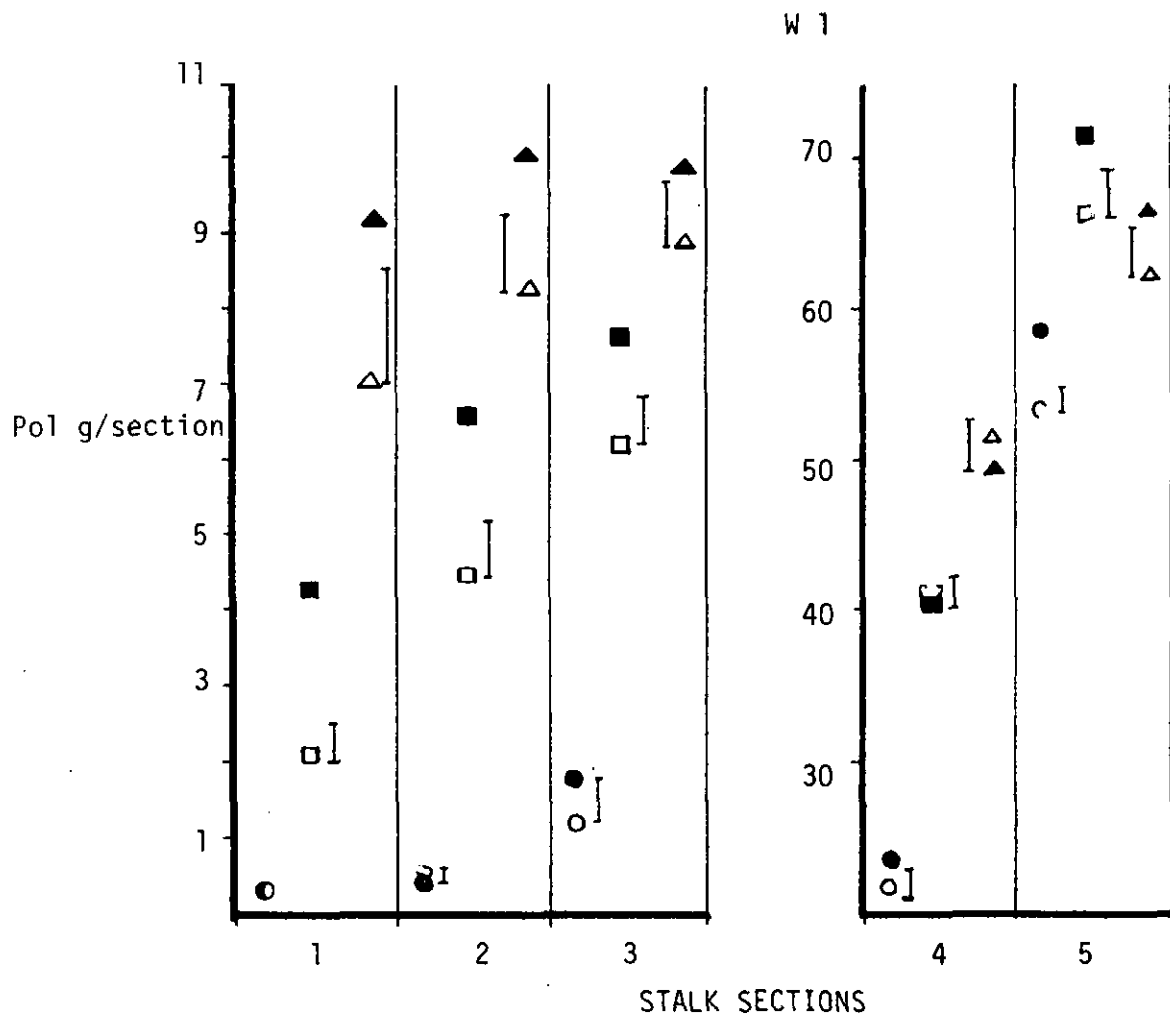
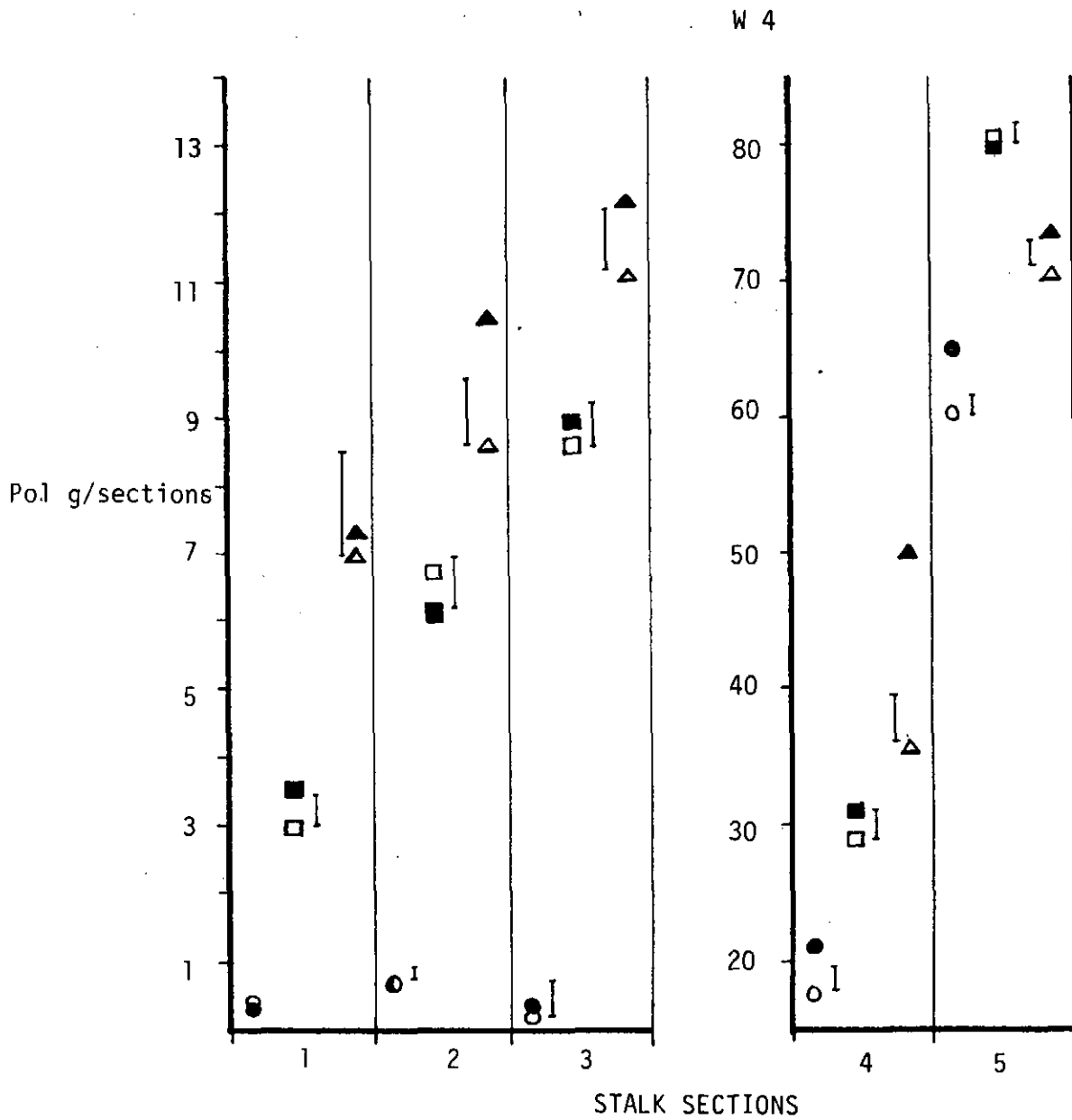


FIGURE : 3b EFFECT OF TREATMENTS ON SUCROSE MASS



Dates = 19/4 8/6 10/7

CW = ○ □ △

RW = ● ■ ▲

] Bar denotes SE.D

FIGURE: 4 LEAF WATER POTENTIALS (ψ_l)

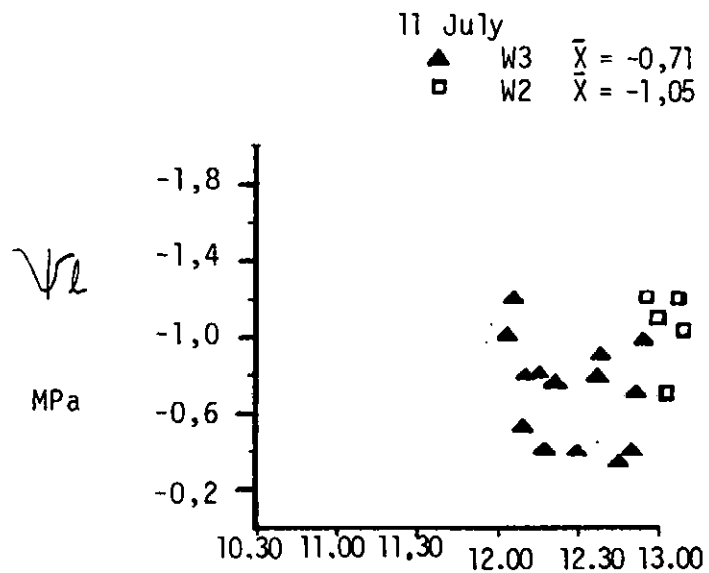
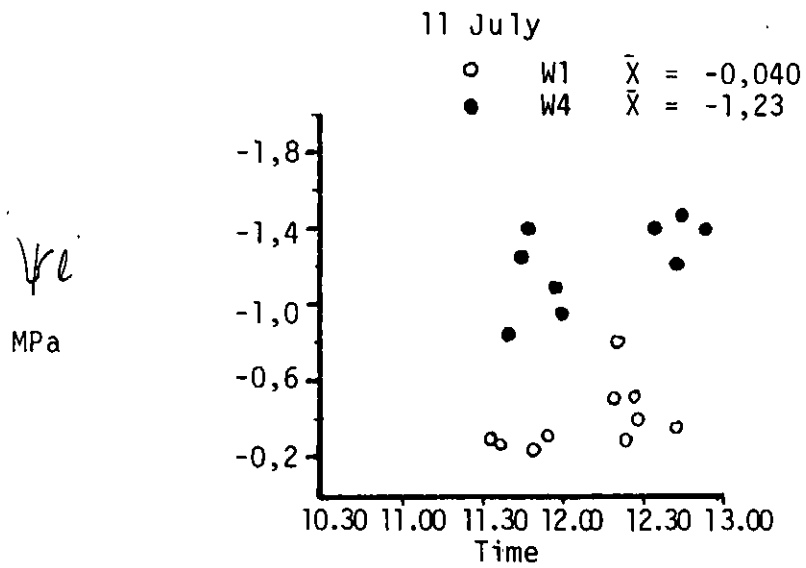
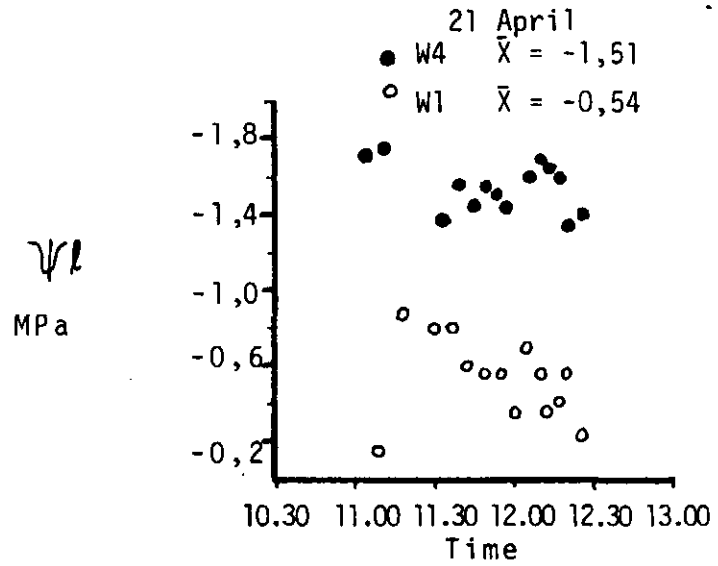
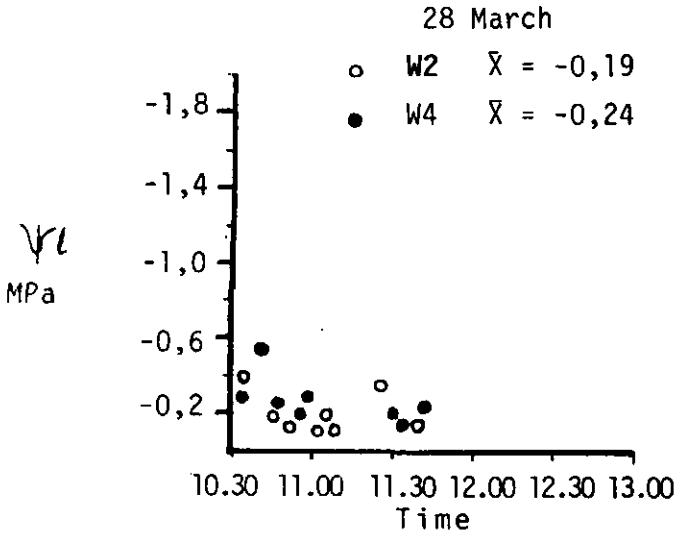
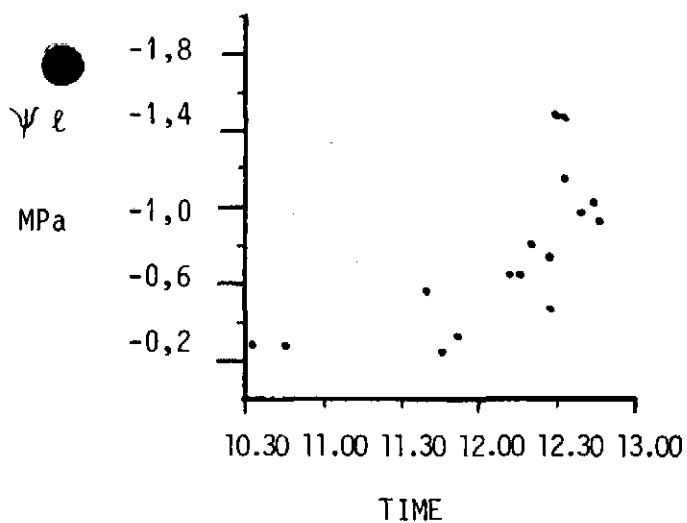


FIGURE 5: LEAF WATER POTENTIALS (Ψ_l)

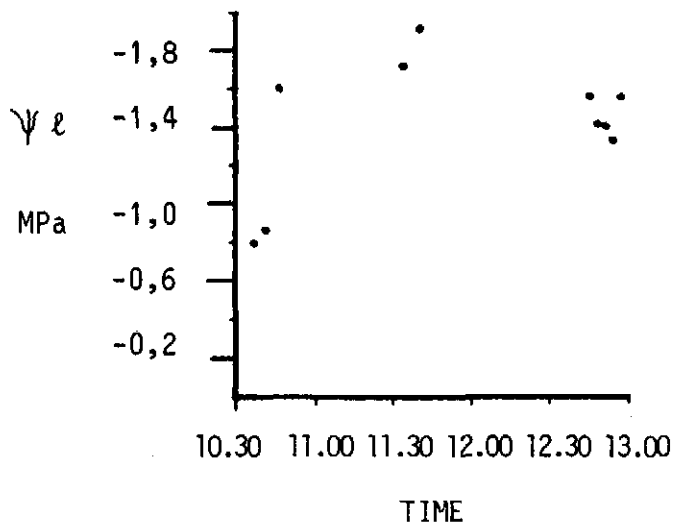
24 July

W1 $\bar{x} = -0,75$



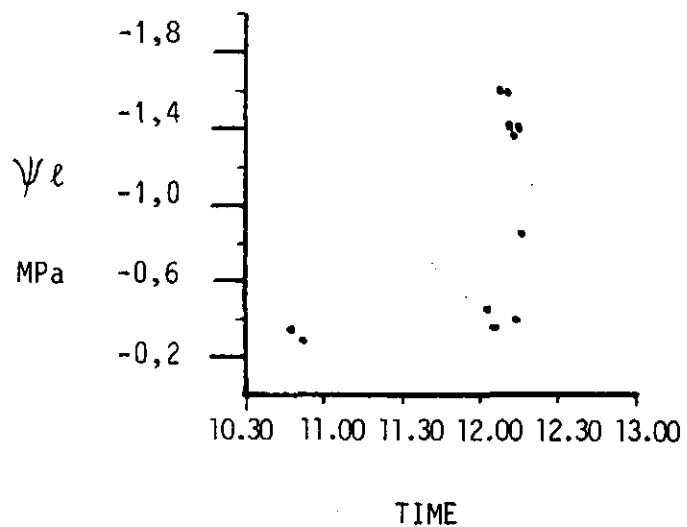
24 July

W4 $\bar{x} = -1,40$



24 July

W3 $\bar{x} = -0,91$



24 July

W2 $\bar{x} = -1,12$

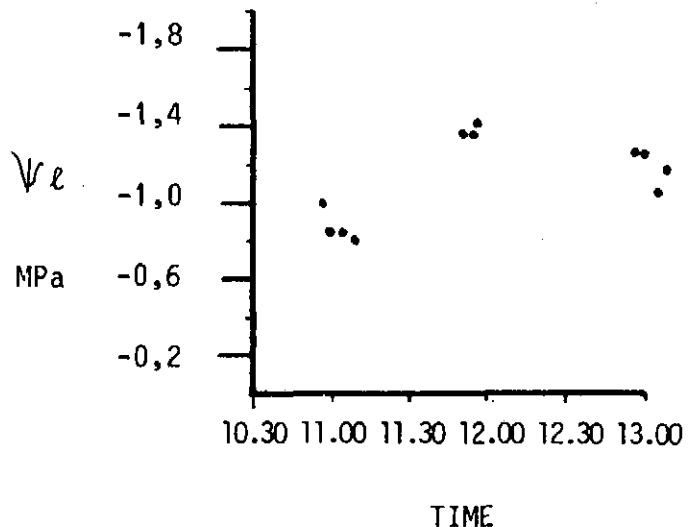


FIGURE 6: LEAF WATER POTENTIALS (MEANS)

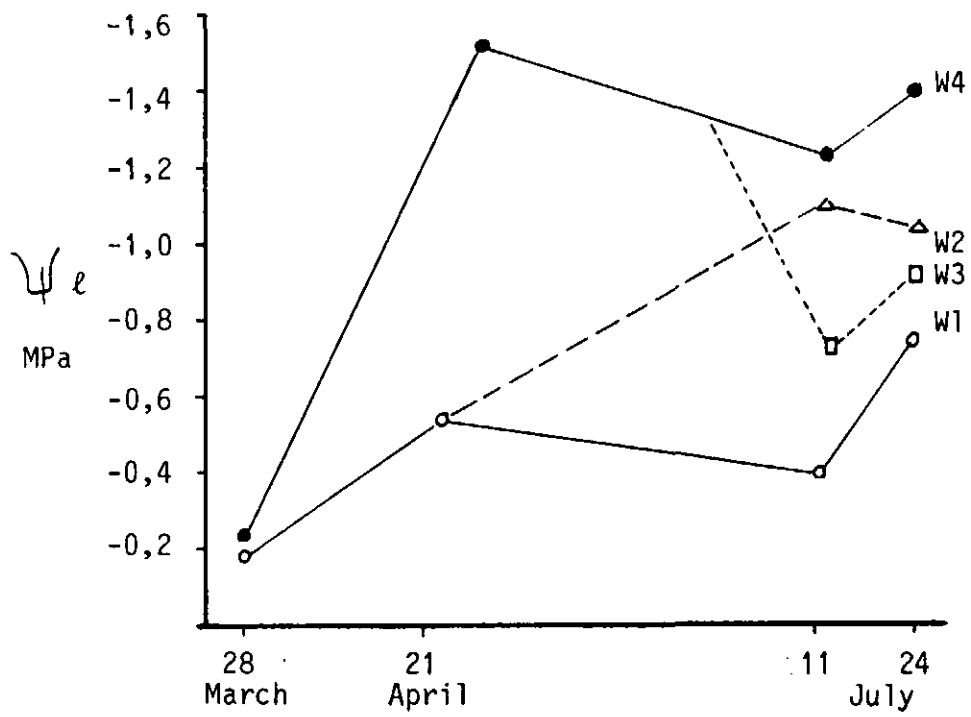


FIGURE: 7 MEAN TEMPERATURES AND DAILY RAINFALL

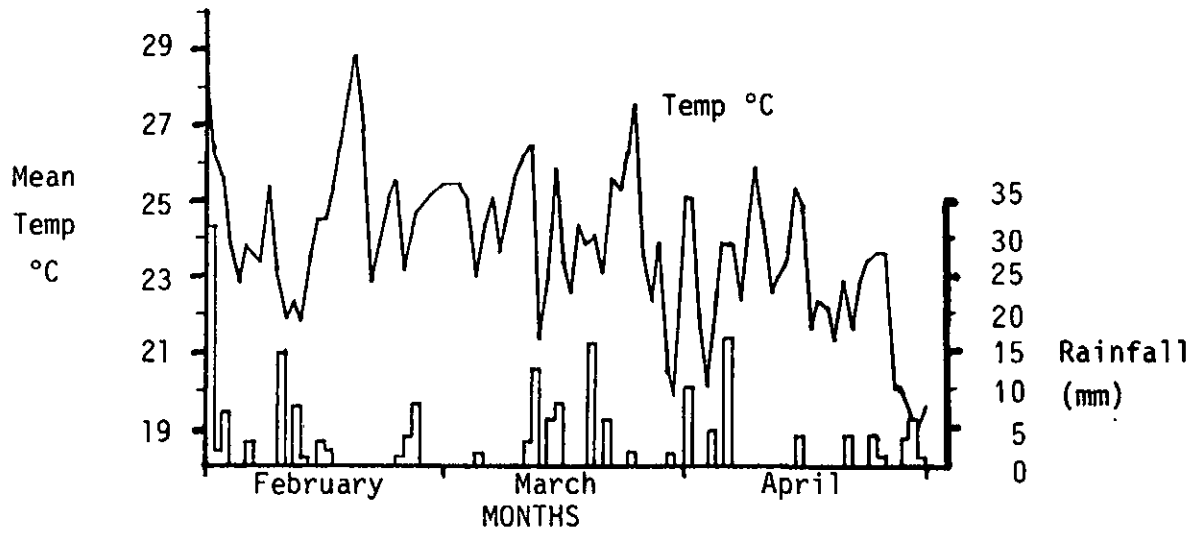


FIGURE: 8 PLANT EXTENSION RATES (PER) TEMPERATURES AND RAINFALL

