SOUTH AFRICAN SUGAR INDUSTRY

AGRONOMISTS' ASSOCIATION

ZIMBABWE SUGAR ASSOCIATION EXPERIMENT STATION

8210/15 FROST DAMAGE TRIAL

TERMINAL REPORT

Catalogue No.: 1210

Object: To study the effects of simulated frost on six month old sugarcane.

This crop: Plant **Age:** 6 months.

Location: ZSA Experiment Station.

Soil type: P.E. 1 sandy clay loam in 3 250cm^3 asbestos pots.

Design: Randomised blocks, 3 treatments in 6 replications.

Variety/spacing: NCo 376, 1,5m between rows of pots.

Fertiliser: Preplanting - 20 g single super phosphate mixed in the top 10cm of soil.
Nitrogen broadcast initially at weekly intervals and then twice weekly when stalks started to elongate rapidly to ensure rapid uninterupted growth.
Potassium chloride was broadcast in light applications once a fortnight during the period of rapid stalk elongation.

Irrigation: Once every two days during tillering and daily thereafter.

Treatments: Subzero temperatures and duration

1. Control
2. -2°C for 2 hours
3. -2°C for 4 hours

Conduct: Sugarcane was grown from one-eyed setts in 3 250 cm^3 asbestos pots in rows 1,5m apart. Plants were grown in pots out-of-doors and transferred to a coldroom for simulated frost treatments. Plots consisted of 12 pots and at each fortnightly sampling one stalk was randomly selected from each pot, nine of which were randomly selected for frost injury parameters and sugar content and the remaining three for dry mass.

RESULTS: See attached tables.

2./ a) Fresh .....

a) Fresh and dry mass per stalk

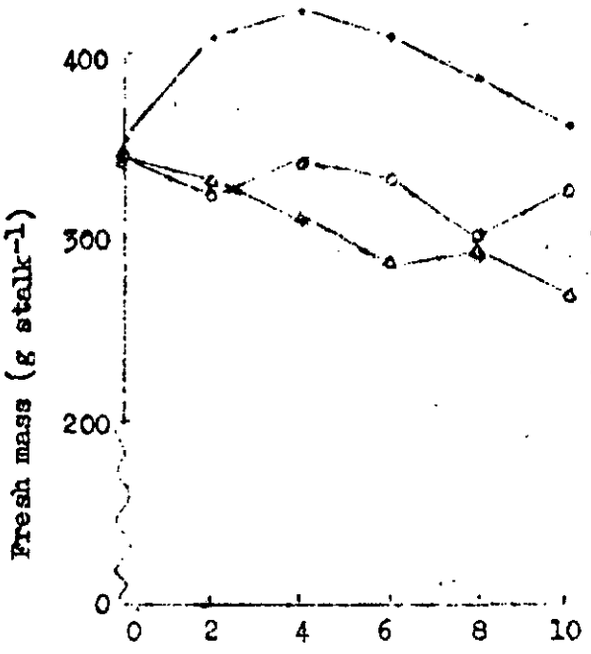

Fig.1. Effect of durations of frost on fresh mass.

Control (•),
-2°C for 2 hours (o),
-2°C for 4 hours (Δ).

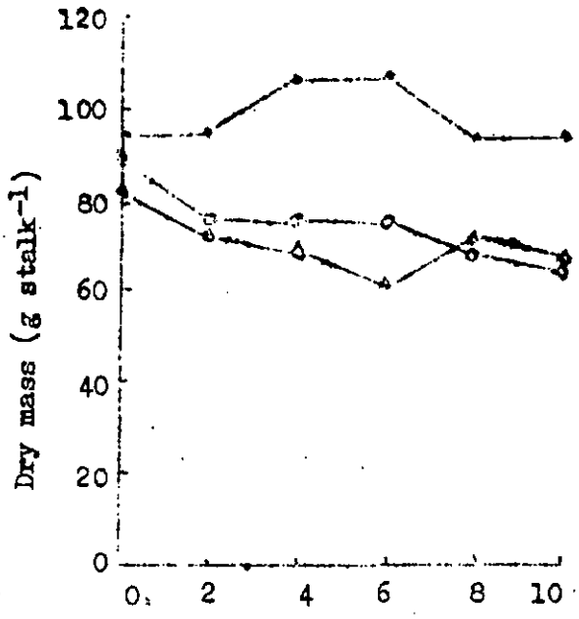

Fig.2. Effect of durations of frost On dry mass.

Control (•),
-2°C for 2 hours (o),
-2°C for 4 hours (Δ).

Although differenees between durations of frost on fresh and dry mass tended to be erratic there was overall a greater decline in fresh and dry mass after simulating frost at -2°C for 4 hours than at -2°C for 2 hours.

3./ b) Per cent .....

b) Per cent dead lateral buds and disease infected internodes

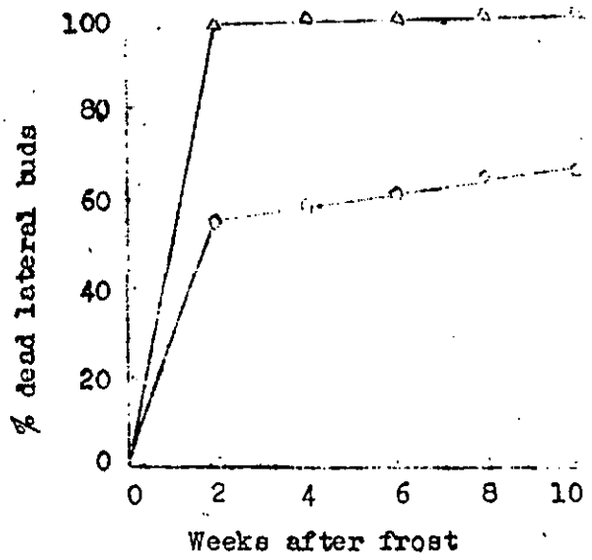

Fig.3. Effect of duration of frost on the death of lateral buds.
-2°C for 2 hours (o),
-2°C for 4 hours (Δ).

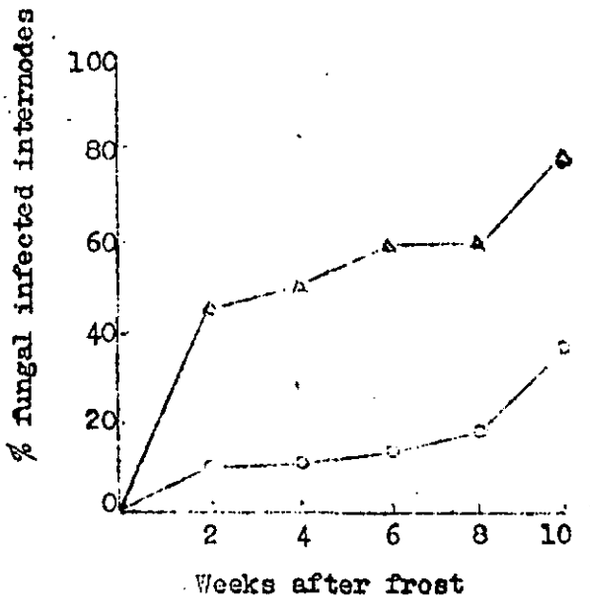

Fig.4. Effect of duration of frost on disease infected internodes.
-2°C for 2 hours (o),
- 2°C for 4 hours (Δ).

In both durations of frost i.e. -2°C for 2 or 4 hours, all apical buds were killed and it was observed that the bottom older lateral buds on the stalks were more resistant to frost damage than the top younger lateral buds. Hence more lateral buds were killed after frosts lasting four hours than two hours, and most deaths were recorded two weeks after simulating frost.

The number of internodes which became infected with fungi (Fusarium spp) was dependent on the severity of frost damage to lateral buds which enabled fungi to gain entry to infect the node and later the internode resulting in the break down of internode tissue. Hence the greater infection of internodes after four hours than two hours.

c) Pol % cane

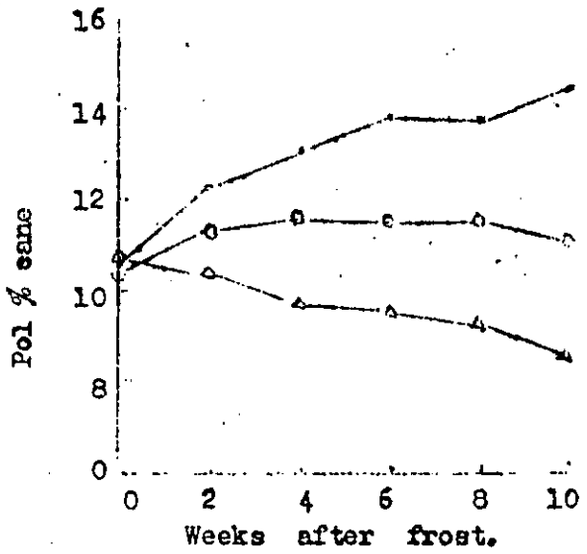

Fig. 5. Effect of duration of frost on Pol % cane.
Control (·).
-2°C for 2 hours (○)
-2°C for 4 hours (△)

Concentrations of Pol (sucrose) increased in the control with age while simulating frosts for two hours had little effect on Pol concentrations up to 10 weeks after frost. However, increasing the duration of frost from two to four hours resulted in a linear decline in Pol concentrations.

d) Grammes sugar per stalk

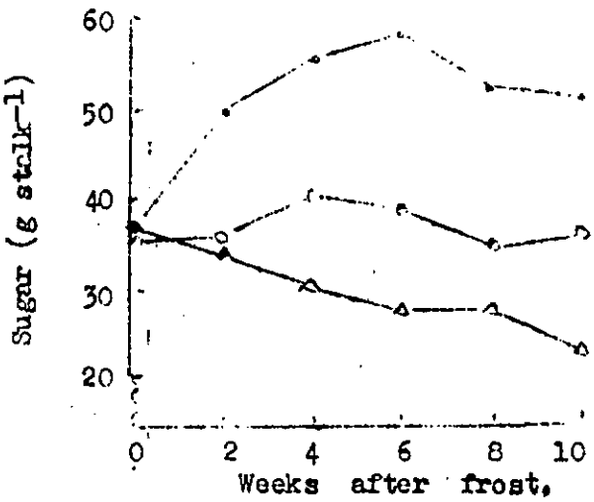

Fig.6. Effect of duration of frost on sugar storage.
Control (·)
-2°C for 2 hours (○)
-2°C for 4 hours (△)

The lack of a linear increase in the accumulation of sugar with time in the control between weeks 6 and 10 suggests that more of the larger older stalks were sampled between weeks two and six. After simulating frost at $-2^{o}C$ for 2 hours, sugar content per stalk remained relatively constant up to 10 weeks later, while there was a linear decline in sugar content when the duration of frost was increased from two to four hours.

CONCLUSIONS

This experiment has shown that the sugar content in maturing internodes is normally sufficiently high to ensure that their juices will not be frozen when frosts occur in the Zimbabwe Lowveld. However the high moisture and low sugar content in the apical bud and adjacent internodes gives little protection. Hence this area is easily frozen at temperatures just below freezing. Similarly lateral buds especially those belonging to the younger phytomers are also easily frozen by relatively short duration frosts while the older lateral buds at the bottom of the stalk are hardier and hence more tolerant to frost damage.

The rotting of the more mature internodes after frost is associated with secondary fungal (Fusarium spp) infections via the dead lateral buds. The numbers of internodes infected are largely dependent on the severity of frost damage to lateral bud tissue.

R.J.H./Oct. '80.
rw

3210/15 FROST TRIAL DATA - PLANT CROP

Frost treatments	Weeks after frost	Fresh mass g stalk^{-1}	S.E. ± at each sampling	Dry mass g stalk^{-1}	S.E. ± at each sampling	% dead lateral buds	% Fungal infected internodes	Pol % cane	S.E. ± at each sampling	Sugar g stalk^{-1}	S.E. ± at each sampling
Control	0	352	40,6	94	13,3	[illegible]	0	10,49	0,90	37	5,2
	2	407	47,2	95	17,8	[illegible]	0	12,16	0,81	50	7,2
	4	425	37,9	107	17,3	[illegible]	0	13,[illegible]	0,75	55	5,8
	6	411	47,1	108	18,0	[illegible]	0	13,78	0,37	57	6,0
	8	389	53,8	93	35,6	[illegible]	0	13,64	0,62	53	7,2
	10	360	27,4	93	14,0	[illegible]	0	14,16	0,52	51	4,9
Significance	0 vs 10	P=0,01	-	N.S.	-	-	-	P=0,01	-	P=0,01	-
- 2°C for 2 hours	0	347	2[illegible],2	89	11,6	[illegible]	0	10,41	0,65	36	3,8
	2	324	48,8	76	12,7	[illegible]	10	11,21	0,59	36	5,0
	4	342	45,2	76	10,1	[illegible]	11	11,60	0,61	40	5,6
	6	329	52,4	75	17,7	[illegible]	13	11,59	0,92	38	6,0
	8	301	54,6	68	17,9	[illegible]	13	11,55	0,60	34	4,6
	10	326	23,1	66	11,9	[illegible]	36	10,93	0,85	36	5,4
Significance	0 vs 2	P=0,01	-	P=0,01	-	-	-	P=0,01	-	N.S.	-
	0 vs 4	P=0,01	-	P=0,01	-	-	-	P=0,01	-	P=0,01	-
	0 vs 6	P=0,01	-	P=0,05	-	-	-	P=0,01	-	P=0,05	-
	0 vs 8	P=0,01	-	P=0,05	-	-	-	P=0,01	-	P=0,01	-
	0 vs 10	P=0,01	-	P=0,05	-	-	-	P=0,01	-	N.S.	-
- 2°C for 4 hours	0	345	28,6	81	9,2	[illegible]	0	10,83	0,64	37	3,5
	2	330	18,6	72	10,2	[illegible]	44	10,33	0,55	34	3,0
	4	310	29,1	69	13,9	[illegible]	49	9,72	0,54	30	3,4
	6	286	20,1	61	8,4	[illegible]	58	9,52	1,09	27	4,5
	8	295	26,1	72	5,0	[illegible]	58	9,14	0,45	27	3,4
	10	270	40,8	67	14,6	[illegible]	78	8,56	0,43	23	4,7
Significance	0 vs 2	P=0,01	-	P=0,01	-	-	-	P=0,01	-	P=0,01	-
	0 vs 4	P=0,01	-	P=0,05	-	-	-	P=0,01	-	P=0,01	-
	0 vs 6	P=0,01	-	P=0,05	-	-	-	P=0,01	-	P=0,01	-
	0 vs 8	P=0,01	-	P=0,01	-	-	-	P=0,01	-	P=0,01	-
	0 vs 10	P=0,01	-	P=0,05	-	-	-	P=0,01	-	P=0,05	-