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BUREAU OF SUGAR EXPERIMENT STATIONS
QUEENSLAND, AUSTRALIA

PROJECT REPORT BR109
THE PROMOTION AND DELAY OF FLOWERING

by

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Several aspects of promoted flowering and delayed flowering were examined in small experiments at Meringa. These have application in the controlled flowering of parent varieties to facilitate a greater range of parent combinations. Results from some experiments are inconclusive and suggest further research. A useful collection of papers on flowering in sugar cane is contained in the Proceedings of the 11th ISSCT Congress, pages 505-545.

1. DELAYED FLOWERING

1.1 Lopping schedules

Free flowering parent varieties are routinely lopped around 22nd February and/or 22nd March. In 1978, three lopping schedules were applied to 10 free flowering parents.

1. Control, lopped 22nd February, 22nd March.
2. Lopped 1st February, 2nd March.
3. Lopped 1st February, 2nd March, 22nd March.

The varieties and treatments were rated and ranked for stage of flowering on 17th May (Table 1). These results indicated that early lopping (treatment 2) was less effective than the control, with little difference between the control and treatment 3. Three more lopping schedules were applied to the same 10 varieties in 1979.

4. Control, lopped 22nd February, 22nd March.
5. Lopped 22nd February, 22nd March, 6th April.
6. Lopped 6th March, 6th April.

The varieties and treatments were again rated and ranked for stage of flowering on 30th April (Table 1). Very little difference was evident between the three lopping schedules although the late lopping (treatment 6) produced the most advanced flowering in five varieties.

Table 1

Observations on rate and rank of flower emergence
in varieties subjected to various lopping schedules

Variety	1978			1979		
	Lopping ¹ schedule	Ranked and rated ² flower emergence 17th May		Lopping ¹ schedule	Ranked and rated ² flower emergence 30th April	
63B61	1			4	1	2-4
	2	Low lopping		5	1	2-4
	3	"		6	1	2-4
CP59-73	1			4	2	2-3
	2	Low lopping		5	2	2-3
	3	"		6	1	2-3
CP52-68	1	3	0-3	4	1	0-2
	2	1	0-5	5	1	0-2
	3	2	0-3	6	1	0-2
CP44-101	1	3	3-5	4	1	0-2
	2	1	4,5	5	1	0-2
	3	2	4,5	6	1	0-2
CP45-184	1	1	0-2	4	2	0-1
	2	1	0-2	5	2	0-1
	3	1	0-2	6	1	0-2
CP47-193	1	2	3-5	4	1	2,3
	2	1	4,5	5	1	2,3
	3	3	3-5	6	1	2,3
CP48-117	1	2	0-2	4	2	0-1
	2	1	0-3	5	2	0-1
	3	3	0-1	6	1	0-2
CP51-21 (1979:CP44-155)	1	2	0-3	4	1	0-2
	2	1	0,3	5	1	0-2
	3	2	0-3	6	1	0-2
Co617	1	2	0-3	4	2	0-2
	2	1	0-5	5	2	0-2
	3	2	0-3	6	1	0-3
NCo310	1	2	0-5	4	2	1-3
	2	1	0-5	5	3	1-3
	3	2	0-5	6	1	1-3

Note 1. Schedule 1 Control (22nd February, 22nd March)
2 1st February, 2nd March
3 1st February, 2nd March, 22nd March
4 Control (22nd February, 22nd March)
5 22nd February, 22nd March, 6th April
6 6th March, 6th April

2. Rank 1 = Most advanced
Rate 0 = No evidence
1 = Node elongation
2 = Flagging
3 = Flower emerging
4 = Top florets open
5 = More advanced

In summary, early lopping (1st February, 2nd March) and late lopping (6th March, 6th April) were less effective in delaying flowering than the routine lopping schedule. No apparent differences existed between three loppings and the routine two loppings. These results suggest that no changes be made to lopping schedules.

1.2 Pot trials

During 1978, observations on two free flowering varieties grown in pots suggested that use of high nitrogen application, lopping and night interruption by light would delay or prevent flowering. These observations have not been detailed but were sufficient to suggest several small pot trials which were implemented during 1979. The same eight free flowering varieties, grown in vermiculite, were used in each trial:-

1. Fortnightly foliar application of urea at two rates:-

- (a) 20 g urea/2 litres water
- (b) 60 g urea/2 litres water

Urea applications were made on 19th February, 6th March and 23rd March. Each variety had nine pots per treatment.

2. Night interruption with lights between 2300 and 0200 each night. Interruption commenced 21st February and ceased on 23rd March in one treatment, and on 7th April in the other treatment. Light was provided using 200W incandescent bulbs at 1.0 to 1.5 m above the canopy and spaced at 7 m² per light. Each variety had 15 pots per treatment.

3. Control; pot grown varieties.

Wind damage in pots before separation to various treatments resulted in nine pots each of only four varieties being allocated to the control treatment. All treatments received monthly applications of liquifert at 1.0 g/pot up to and including December 1978. Observations on stages of flowering were recorded during April and May (Table 2). Foliar application of urea appeared to have little if any effect on flower emergence. CP48-103 was less advanced at both rates of application and CP44-155 was less advanced with the high rate. Night lights effectively prevented flowering. It is probable that day length after 23rd March was too short for floral initiation in these early flowering varieties. Future work on this should include night interruption for shorter periods (i.e. cease in early March) and use of lights to produce 12.5 hours of daylight after the night interruption has ceased. Further observations in late August showed that four varieties in both treatments had 20 to 100 per cent flowered stalks.

1.3 Field application of nitrogen

Five free arrowing varieties were planted (May, 1978) in unreplicated plots to observe the effect on flowering of nitrogen application. No fertilizer was applied at planting, in line with routine parent variety practices, and approximately 300 kg/ha of N, as urea, was applied to the

Table 2
Rated¹ flower emergence in delayed flowering trials

Variety	Treatments								Field N.			
	Control		Foliar N. 20 g		Foliar N. 60 g		Light to 23rd March	Light to 7th April	Control		High N	
	3rd April	14th May	3rd April	14th May	3rd April	14th May	14th May	14th May	+L	-L	+L	-L
67N408			0	3-5	0	2-5	0	0				
Co617			0	5	0	5	0	0-1				
CP52-68	0	3,4	0	3,4	0	3,4	0	0	0-2	0-2	1-2	1-2
CP44-155	0	3-5	0	4,5	0	3	0-1	0	0-2	1-2	0-2	0-2
64B33			0-1	2-5	0-1	5	0-1	0-1				
CP48-103	0	3,4	0	2-4	0	0-3	0	0	0-3	0-3	1-2	1-2
NCo310			0	2-5	0	3-5	0	0	0-2	1-3	0-2	1-3
CP44-101	0	3-5	0-1	4,5	0-1	5	0-1	0-1	1-2	0-3	1-2	0-2

1. Rated 0-5 as in Table 1

high N plots on 24th December. Half of each plot was lopped during routine February and March lopping. Stages of flower emergence were rated on 30th April (Table 2). No differences were evident between the control and high N plots. This may be attributed in part to very high January rainfall, when 1 650 mm of rain was recorded, commencing with heavy and continuous rain only one week after the N application.

2. PROMOTED FLOWERING

2.1 Flowering sites

Van Breeman *et al.* (1962) recorded more flowering from more varieties at an altitude of 1 500 feet. Preliminary studies in Queensland showed that flowering at Myola (leaf scald testing plot near Kuranda) was more abundant for certain varieties than at Meringa. During 1978, 25 sparsely flowering varieties were planted to unreplicated 25 m plots at four sites:-

1. Poolwood Road, Smithfield
2. Myola
3. D.P.I. Station, Walkamin
4. D.P.I. Station, Kairi

Twenty three of these varieties were growing in the parent collection at Meringa and 17 were in the Freshwater flowering plot. From the site information in Table 3, elevation ranged from near sea level to a maximum of 580 m at Kairi. Kairi is regularly frosted, hence the late planting date. Plot sizes varied at Meringa (Table 4) and were 3 rows x 5 m at Freshwater. The Poolwood Road trial was incorporated in a commercial planting. The Myola trial was on previous leaf scald test sites, with total chemical weed control after filling-in. The Walkamin trial was on previously used pasture grass introduction plots and the Kairi trial was on land previously planted to corn. Both the Kairi and Walkamin plots were regularly spray irrigated from planting through to the wet season.

Observations on flowering were recorded on 16th May and 22nd June during the 1979 crossing season and are recorded in Table 4. Stage of flowering was recorded on a 0-5 scale (Table 4). There was insufficient time to count flowered and non-flowered stalks and flowering stalk frequencies were visually allocated to one of three classes. A few sample counts placed frequencies at <5 per cent (class A), five to 20 per cent (class B) and >20 per cent (class C). The early inspection indicated that the Walkamin plot would flower freely with shy coastal flowering varieties such as B49119 and Q113 already freely available for crossing. The second inspection figures in Table 4 verify this, and these figures may be summarized as follows:-

	Percentage of varieties flowering 22nd June, at :-					
	Meringa	Freshwater	Poolwood	Myola	Walkamin	Kairi
<u>Total</u>	65	41	56	84	100	64
Frequency C	0	0	16	32	68	20
B	35	24	8	32	28	20
A	30	17	32	20	4	24
At stage 4 or older	52	29	48	52	76	20

The Walkamin plot was outstanding in that all varieties flowered, 68 per cent of them freely. Additionally, 76 per cent of the varieties were sufficiently advanced to be usable for crossing on or before 22nd June. Twenty-one varieties (84 per cent) flowered at Myola with only 32 per cent flowering freely and flowering was generally not as advanced. Similar numbers of varieties flowered at Meringa and Kairi although the intensity of flowering was much greater at Kairi. No varieties flowered freely at Meringa or at Freshwater. Fewer varieties flowered at Poolwood Road than at Meringa although four (16 per cent) flowered freely. Varying plot size at Meringa (Table 4) may have affected flowering comparisons in the low frequency classes, but generally the intensity of flowering at Walkamin, and to a lesser extent Myola, far exceeded that at any other site.

Considerable variety x site interactions were apparent. Co475, 66C800, Q113 and Zeus flowered freely on all elevated sites (Table 4) but failed to flower or flowered sparsely on the coast. B49119 flowered freely at Myola and Walkamin, but not at Kairi (highest elevation) or on the coast. Q101 and H49-104 flowered moderately at Meringa, Poolwood Road and Walkamin, and very sparsely or nil at other sites. Q83 flowered moderately at Poolwood Road, Myola and Walkamin. Q107 was available for crossing only from Poolwood Road.

Throughout the crossing season, flowers were collected from all plots except Kairi. Collection was concentrated at Poolwood Road and Walkamin. From Walkamin flowers were used from 15 parents for a total of 88 crosses. Seedling germination from these crosses will be recorded. Cane growth at Walkamin was exceptional with some plots estimated at 180 tonnes per hectare.

Extensive weather records are maintained at Walkamin and Kairi. Limited comparisons with data from Meringa are made in Figure 1. Daily data were averaged over weekly periods for the first 28 days of March-June 1979. Kairi has consistently higher relative humidity than Walkamin at 0900 daily whereas Meringa fluctuates above and below these levels. Sites differentiate readily for daily maximum and minimum temperatures with Walkamin intermediate to Meringa (high) and Kairi (low). Probably the most evident differences between Walkamin and the other sites occur for hours of sunshine per day. From measurements taken at Meringa, there is potential for 12.2 hours of sunlight per day in early March. Given that a 12.5 hour day length is accepted as optimal for flower initiation, this shorter potential day length and frequent heavy cloud cover at Meringa may be sub-optimal. I consider that Myola and Poolwood Road would have greater periods of sunlight than Meringa or Kairi. Although this is only conjecture

Table 3
Details of flowering sites

Site	Planted	Fertilizer	Irrigation	Elevation (m)
Poolwood Road	12/6/78	Aqua 560 kg/ha preplant CK44 380 kg/ha	Nil	5
Myola	4/4/78	CK44 380 kg/ha	Nil	320
Walkamin	5/4/78	CK44 380 kg/ha	Regularly	580
Kairi	11/8/78	CK44 380 kg/ha	Regularly	714
Meringa	May-June 1978	Nil	Nil	15
Freshwater	13/6/78	Nil	Nil	5

Table 4

Plant cane observations : Most advanced stage¹ of
flowering and intensity² of flowering

Variety	Meringa			Freshwater			Poolwood Road			Myola			Walkamin			Kairi		
	Plot size (m)	16th May	22nd June	Plot size	16th May	22nd June	Plot size	16th May	22nd June	Plot size	16th May	22nd June	Plot size	16th May	22nd June	Plot size	16th May	22nd June
B49119	34.0	0	5A	15 m	0	0	25 m	1A	5A	25 m	4C	5C	25 m	4C	5C	25 m	0	0
60C721	12.6	0	5A		0	0		0	0		2C	5C		2C	5C		0	3B
61C655	13.0	2B	5B	-				3A	5A		4C	5B		5C	5C		3C	5C
66C800	13.0	0	0	-				0	0		2C	5C		2C	5C		2C	4C
Co475	12.6	(R) ³ 2A	5A		0	0		0	0		2B-C	5C		2C	5C		2C	5C
H49-104	57.0	1B	5B		0	5B		2A	5B-C		0	0		1B	2B		0	0
H50-3511	90.0	1B	5B		0	5B		1A	5A		0	2A		2C	5C		0	2A
H56-752	11.3	0	1A		0	0		0	3A		0	0		0	3B		0	0
62N1062	22.6	1A	5B		0	5B		2B	5C		1A	5B		1C	5B		0	2B
63N21	-			-				0	0		1B	5B		1B-C	5C		0	0
63N362	11.3	0	0	-				0	0		1B	3B		1C	4C		1A	2A
64N3722	11.3	1A	4A		0	3A		0	0		0	0		0	2C		0	0
65N980	11.3	0	0		0	0		0	0		1A	3C		1C	5C		0	2A
Q83	113.0	0	5A		0	0		1A	4B		1A	4B		2B-C	5B		0	2A
Q84	12.6	(R)0	0		0	0		0	0		1A	4A		1B	5B-C		0	0
Q90	26.0	0	0	-				0	0		1B	2B		1B-C	4B		0	2A
Q98	12.6	1B	5B	-				2C	5C		1C	3C		2C	4C		1A	2B
Q99	90.0	0	3A		0	1A		1A	5A		0	2A		1A	3B		0	0
Q100	-				0	0		0	3A		0	0		0	2A		0	0
Q101	21.0	2A-B	5B		0	5A		4A	5B-C		0	2A		2C	5C		0	2A
Q102	12.6	0	0	-				1A	4A		1B	4B		1C	5C		1B	2B
Q107	12.6	0	1B	-				2A	5B		0	2A		1B	2B		0	0
Q113	11.3	0	0		0	0		0	0		2C	5C		3C	5C		2C	5C
61S14	12.6	(R)0	5A		0	0		0	0		2C	5C		2C	5C		1B	2B
Zeus	12.6	0	0		0	5B		2A	5A		1B	5B		2C	2C		2C	5C

1. Stage 0 : Non flowering

1 : Last node elongation

2 : Flag leaf evident

3 : Flower emerged

4 : Florets open (suited for crossing)

5. Fully opened and older

2. Intensity A : <5%

B : 5-20%

C : >20%

3. (R) = Ratoon crop

it would explain the greater intensity of flowering at these sites. Daily dry bulb, wet bulb, RH0900, RH mean hourly, maximum, minimum and mean hourly temperatures, terrestrial minimum and earth temperature at 12 cm, 20 cm, solar radiation, evaporation, cloud cover, hours of sunlight and rainfall are filed for Kairi and Walkamin.

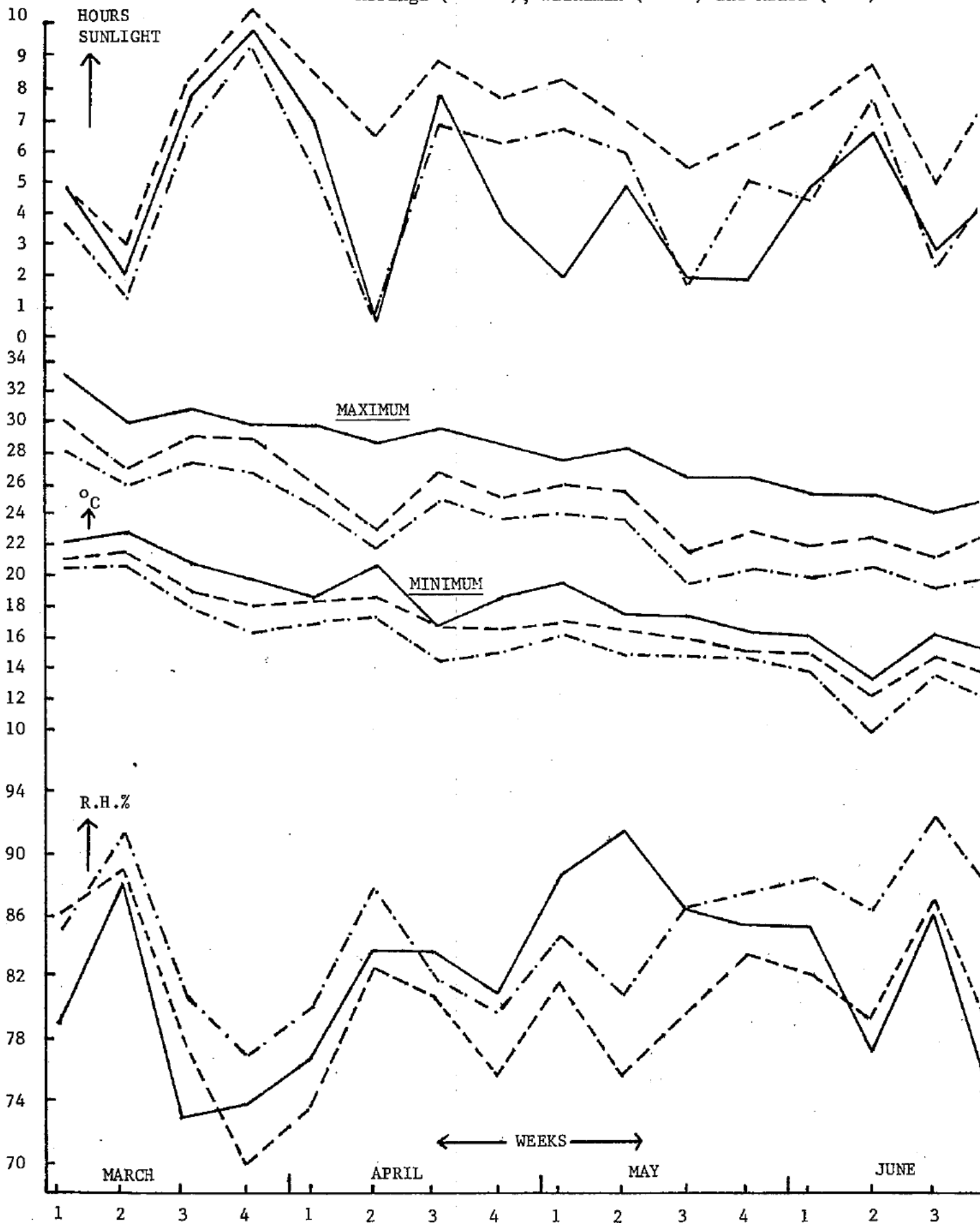
The Walkamin plot was hand cut on 5th July and the Poolwood Road plot was ratooned following routine harvest. Ratoon cultivation and irrigation at Walkamin has been supervised and implemented by the Walkamin station manager. At both Walkamin and Kairi excellent co-operation and assistance has been received from DPI staff throughout the running of this project. The Myola and Kairi plots will be abandoned this year.

2.2 Supplementary dawn lighting, potted canes

As mentioned before, limited measurements at Meringa indicated that 12.2 hours would elapse from sunrise to sunset in early March. Twenty-four of the varieties used for 2.1 were grown in pots at Meringa. Constant artificial dawn at 0550 was provided with 200 Watt incandescent bulbs spaced at 9.5 m² per bulb. Artificial dawn commenced on 21st February and coupled with the natural change in sunset, potentially provided 12.5 hours of light around 6th to 10th March. Lights were switched off on 20th April. Flower initiation was virtually nil. Inspection on 14th May revealed only Q102 at stage 1 (elongation). Further inspection on 22nd June showed three varieties (60C721, 63N362, Q102) had produced a couple of flowers each. The time clock used in this trial was not reliable, gaining about 10 minutes during the first week, although it was regularly altered thereafter. Further research is necessary to determine optimum light intensity and pre-dawn scheduling of lights.

Apart from the plots at Walkamin and Poolwood Road, no further flowering research is intended for Meringa at this stage.

Figure 1 Weekly average daily hours of sunlight and temperatures and relative humidity at 0900 for 16 weeks from March to June 1979 for Meringa (—), Walkamin (- - -) and Kairi (-.-.-)



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