BUREAU OF SUGAR EXPERIMENT STATIONS

QUEENSLAND, AUSTRALIA

SRDC PROJECT - FINAL REPORT
BSS158 – HIGH DAY TEMPERATURE INHIBITION OF SUGARCANE FLOWERING

by

N Berding[1] and R W King[2]

SD00014

[1] Dr Nils Berding, BSES Meringa, PO Box 122, Gordonvale Q 4865 (Phone 07 4056 1255)
[2] Dr Rod King, CSIRO Division of Plant Industry, PO Box 1600, Canberra ACT 2601

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NON-TECHNICAL SUMMARY

Currently, use of the photoperiod facility (PF) at BSES Meringa is limited to 'winter' initiations falling between 1 April and 30 September. Initiations conducted outside this period produce poor levels of success, primarily because excessive temperatures during the initiation phase are detrimental. This limits use of the facility to once per year, thus increasing the unit cost of crosses made in the facility. Two successful initiations per year could be conducted if research leads to an understanding of the nature of this temperature inhibition, and to a means of alleviating this. Production of twice the number of crosses would allow the capital cost of the facility to be apportioned to twice the output, making the R&D investment considerably more attractive. In addition, the ability to make the most desirable combinations among the parental clones used, rather than being content with just the best combinations among parental clones that happen to flower under natural initiation conditions, adds considerable value to the facility's output. This project aimed to test the hypothesis that maximum temperatures exceeding 32°C during the first 60 days of initiation inhibited sugarcane flowering. This period was based on a photoperiod regime with a commencing day length of 12 h 45 min, decreasing by 30 sec per day. Potted plants were raised under glasshouse conditions in the CSIRO phytotron, Canberra, for about 100 days before being placed into large growth cabinets 1.6 m long x 0.79 m wide x 2.44 m high. Five experiments were conducted using three clones (H56-752, H70-0144 and 66N2008) that had a history of variable flowering in the year-round experiments conducted in BSS58. The main comparison was between regimes of 28/24°C (day/night) and 34/25°C. The photoperiod regime used was an initiating day length of 12 h 45 min, reducing by 30 sec per day. The final experiment was modified to compare three different regimes (26/22°C, with a reducing regime as used previously, as well as a constant day length regime of 12 h 45 min, and 24/20°C with the reducing regime. When no initiation resulted from use of the initial regimes, these lower temperature regimes were used as a check that radiant heating of leaves, admittedly in precisely controlled temperature regimes, may be responsible. Two hundred and forty meristems were dissected in the five experiments to reveal none had been initiated. Results of Experiments 1 and 2 were compromised because of over-fertilisation of the potted plants. Generally, even with careful nutrient management, sugarcane plants produced in the phytotron and placed in the large growth ('B') cabinets for initiation tended to be too large by the end of the initiation phase. The consequence of this was that during the initiation phase, the plant canopy grew into the cabinet roof, with the resulting pressure distorting and stressing the meristems. In many instances, even if all environmental stimuli were conducive to triggering initiation, the meristems may not have been receptive to these stimuli. A major conclusion from this study was that the size of the 'B' cabinets used in the CSIRO phytotron was inadequate for sugarcane as grown in this research. Despite increasingly careful nutrient management through the series of five experiments, producing plants that did not grow excessively and stress the meristems through pressure on the cabinet tops proved difficult. Extension lighting was incandescent, which was standard for the 'B' cabinets, but is not optimal for sugarcane initiation. The intensity of extension lighting (2 x 100 W bulbs per cabinet of 1.25 m^2 floor area) was of concern. In fact, the lighting may have been less effective than this given the crowding of the plant canopies at the top of the cabinets and around the lamps. Further upgrading of the lamps above 100 W was not feasible as the lighting circuits in the "B" cabinets were at maximum allowable capacity. This is the first plant species not to have been initiated to flower in the CSIRO phytotron, and CSIRO physiologists are puzzled by this. Early research in South Africa by Dr P G C

Brett suggested attempting initiation of sugarcane under glass was doomed to failure. However, recent results from the BSES Bundaberg PF have shown this is possible, despite the panicle development phase being compromised. Consequently, the hypothesis remains untested. A further attempt to test this hypothesis is highly desirable. The hypothesis is crucial to our understanding of the primary reason for generally poor and variable flowering under natural conditions at BSES Meringa. This failure also limits our ability to specify a natural environment that would be more conducive to operating the PFs more than once a year. The hypothesis cannot be tested without working under glass, given the requirement for precise temperature control during the day. Obviously, provision of adequate vertical space to allow growth of unstressed plants, and use of an optimised extension lighting system for intensity, would be primary specifications in addition to the precision achievable with the temperature regime.

1.0 PROJECT BACKGROUND

Data from experiments in BSS58 and subsequent initiation experiments conducted in the BSES Meringa PF clearly implicated high temperature during the initiation phase as a major environmental factor limiting the initiation of flowering in sugarcane. Of sixteen experiments conducted in which the suite of nine clones used in BSS58 was included, eight could be classified as 'winter' initiations, with the commencement of the initiation regime falling between Julian day 89 and 233, ie from about 1 April to 30 September. Mean initiation of meristems achieved was 67.8%, with a range from 31.5 to 90.4%. In contrast, for initiations conducted in the remainder of the year, or 'summer' initiations from about 1 October to 31 March, the mean meristem initiation recorded was 11.9%. Individual initiations ranged from 0 to 33.8%.

Attempts were made to manipulate temperature regimes during initiation in some of the experiments at BSES Meringa. In Experiments 6 and 7, control of canopy temperature using high pressure misting was relatively successful, but initiation was poor because of a probable confounding between reducing canopy temperature and shading caused by vertical curtains used to confine the misting treatment. In Experiment 6, which commenced initiation on 3 November, there was 0% initiation in the misted treatment versus 4.1% in the full sun treatment. A 50% shade treatment yielded 2.5% initiation. In Experiment 7, established with the same treatments, and which commenced on 16 February, mean initiation in the treatments were 29.4, 33.8 and 25.1%, respectively.

In Experiment 8, a reverse approach was taken, with a trolley of plants being subjected to temperatures > 32°C between 1000 and 1400 hours for seven days by placement in a polycarbonate-clad external enclosure. Initiation commenced on 12 August, and nine trolleys were treated sequentially over the initiation period. Initiation for the control treatment (ambient temperatures throughout) was 38.4% for eight clones excluding H56-752. Average initiation over the eight clones was 40.0, 29.6, 10.7, 20.3, 9.1, 17.0, 29.2, 24.1 and 30.2% for weeks 1 through 9. The result for week 5 (9.1%) should be discounted because the plants sustained considerable damage when the trolley which they were on was dropped when being moved by crane. Although the treatments were not replicated, the data suggested that some clones were sensitive to high day temperatures. A sophisticated temperature controller was used, but it relied on use of cooler external ambient air to moderate temperature in the 'hot-box'. Unfortunately, temperature control was not acceptable, mainly because restructuring of the project resulted in the experiment being conducted later in the year than was desirable.

The reasons for this project are clear with this background. The experimental format and/or the equipment available at BSES Meringa proved unsatisfactory for testing the hypothesis of the effect of high temperatures on initiation of flowering in sugarcane. Access to the CSIRO phytotron in Canberra, by invitation of Drs Rod King and Lloyd Evans, offered the possibility of testing the hypothesis proposed in a rigorous manner, and hope that a definitive answer could be obtained. Development of an optimised management strategy for artificial initiation of sugarcane at BSES Meringa would be an important advance from the knowledge gained. This would allow production of sexual seed from the most desirable parental combinations for the genetic improvement of the Australian sugarcane crop.

2.0 OBJECTIVE AND STATEMENT OF ITS ACHIEVEMENT

Objective: Determine the sensitivity of the floral initiation process in sugarcane to day temperatures exceeding 32°C.

The objective was not achieved because no meristems were initiated in the five experiments conducted, and therefore the hypothesis remains untested. This was despite precise temperature control being effected in the CSIRO phytotron.

3.0 METHODOLOGY AND JUSTIFICATION

3.1 Growth phase

Experiment 1: One-eye setts of the clones H56-752, H70-0144 and 66N2008 were pre-germinated at BSES Meringa and forwarded to the CSIRO phytotron, Canberra. They were established in nominal 16 L pots filled with a potting medium consisting of equal parts of coarse sand, peat and vermiculite, with pH adjusted to 6.0. Plant growth was restricted to the primary stalk in each pot. The plants were raised in a controlled glasshouse environment maintained at 34°C during daylight hours and 26°C during the night. The plants were subjected to long days of 16 h, which removed the possibility of initiation prior to imposition of the photoperiod treatment regime. The plants were watered three times daily, with the pots maintained individually in trays 25 mm deep. These trays were not drained weekly until late in the life of Experiment 1. The plants were fertilised weekly from 9 August 1996 until 8 November 1996 (= 7 applications), then they were fertilised two weekly until commencement of initiation on 8 November 1996 (= 4 applications). The fertiliser used was Wuxal concentrate diluted at the rate of 600 mL to a 40 L distribution tank. Each plant received 800 mL of this diluted solution at each fertilisation. This volume was not as planned, but rather was used arbitrarily because it wetted the surface of the pot.

Experiment 2: Plants were established as detailed for Experiment 1. Glasshouse temperature was reduced to 30°C during daylight hours and 24°C during the night, as compared with 34/26°C in Experiment 1. This was to reduce plant growth, and reduce plant size so they would better fit into the large controlled-environment cabinets. Again, the plants were subjected to long days of 16 h. The plants were watered three times daily, with the trays beneath the pots being drained weekly. The plants were fertilised weekly from 26 November 1996 until 23 December 1996 (= 5 applications). The fertiliser application was as described for Experiment 1.

Experiment 3: Plants were established and managed as detailed for Experiment 2. The plants received no fertilisation at planting, and were fertilised only once during the growth phase. This was applied on 24 August 1998, at a rate of 150 mL of diluted Wuxal liquid nutrient (200 mL of concentrate in 60 L water) per pot, when canopy yellowness had become distinct.

Experiment 4: Plants were established and managed as detailed for Experiment 2. Plants in this experiment received a single dose of 150 mL of diluted Wuxal liquid nutrient (200 mL concentrate in 60 L) during the growth phase (18 June – 10 October 1997) on 24 August 1997.

Experiment 5: Plants were established and managed as detailed for Experiment 2. As in Experiment 4, plants in this experiment received a single dose of 150 mL of diluted Wuxal liquid nutrient (200 mL concentrate in 60 L) during the growth phase.

3.2 Initiation phase

Experiment 1: Plants were moved into the large controlled-environment cabinets on 8 November 1996. Plant density was 18 pots (six replicates x three clones) per cabinet. All cabinets received a commencing day length of 12 h 45 min, reducing by 60 s/2 d. The temperature profile imposed was sinusoidal.

Experiment 2: Plants were moved into the controlled-environment cabinets on 10 February 1997. Plant density was reduced to 12 pots (four replicates x three clones) per cabinet. The photoperiod regime imposed was as described for Experiment 1. Again, the temperature profile was sinusoidal.

Experiment 3: Plants were moved into the controlled-environment cabinets on 10 February 1997. The photoperiod regime imposed and temperature profile used were as described for Experiment 1. No fertiliser was applied during the initiation phase. No trays were maintained under the pots during the initiation phase, but the plants were watered three times daily.

Experiment 4: Plants were transferred to the large controlled-environment cabinets on 11 October 1997. The photoperiod regime imposed and temperature profile used were as described for Experiment 1. Plants were watered three times daily, with the trays being maintained under the pots, but not being emptied weekly. This was done to minimise the possibility plants were not water stressed between watering events. They received a single dose of nutrient, of the same strength as the growth phase dose, once during the initiation phase (16 January 1998).

Plants were subjected to 9 h of natural light during initiation. This was extended to the required photoperiod with 2 x 100 W incandescent bulbs per cabinet. This was an increase from the 2 x 75 W used in Experiments 1 to 3. Our intention had been to increase the strength of the extension lighting by using 4 x 75 W bulbs per cabinet, which would have ensured better distribution as greater intensity of the extension lighting. This proved impossible because the light circuits were operating at their limit and could not handle the increased amperage. This desired change was motivated by a concern that extension lighting was not uniformly distributed across the plant canopies because these were concentrated at the top of the cabinets.

Experiment 5: Plants were transferred to the large controlled-environment cabinets on 4 February 1998. The photoperiod regime imposed was as described for Experiment 1, but was modified for one treatment (GH4B2, Table 2). The problems encountered in this research, and the treatments imposed in Experiment 5, were discussed with Dr Lloyd Evans, CSIRO. Operational costs until the conclusion of Experiment 5 in late April 1998 were carried by the CSIRO's Division of Plant Industry.
This experiment used a range of lower day and night temperature regimes. The purpose was to see whether leaf heating by radiant energy under a double glass structure could be responsible for poor initiation. The regimes used can be compared to 28/24°C and 34/25°C used as the control and hot regimes, respectively, in the earlier experiments. Again, the temperature profile was sinusoidal. Plants were watered three times daily, with

the trays being maintained under the pots, but not being emptied weekly. Plants in GH6B2 were accidentally fertilised a second time, about one month after commencement of this phase. This caused plants to grow against the cabinet ceiling, subjecting the meristems to stress.

Plants were subjected to 10 h 30 min of natural light during initiation, shutters being opened at 06.00 and closed at 16.30. This was extended to the required photoperiod with 2 x 100 W incandescent bulbs per cabinet, as was modified for Experiment 4.

Activities associated with the growth, initiation and assessment of Experiments 1 - 5 are summarised in Table 1. The range of the growth periods was from 77 to 114 days, with a mean growth period of 102 days. The period between commencement of initiation and meristem dissection ranged from 74 to 124 days, with a mean of 101 days (Table 1). Temperatures and photoperiod regimes used in Experiments 1-5 are summarised in Table 2.

Table 1: Summary of activities in Experiments 1-5 of project BSS158 conducted in the CSIRO phytotron, Canberra.

Experiment	Activity		Date	Days elapsed between activities
	Number	Description		
1	1	Plants potted	9 August 1996	
	2	Initiation commenced	8 November 1996	2-1 = 92
	3	Dissection	3 February 1997	3-2 = 88
2	1	Plants potted	26 November 1996	
	2	Initiation commenced	10 February 1997	2-1 = 77
	3	Dissection	25 May 1997	3-2 = 105
3	1	Plants potted	10 February 1997	
	2	Initiation commenced	3 June 1997	2-1 = 112
	3	Dissection	7 October 1997	3-2 = 124
4	1	Plants potted	18 June 1997	
	2	Initiation commenced	11 October 1997	2-1 = 114
	3	Dissection	2 February 1998	3-2 = 114
5	1	Plants potted	21 October 1997	
	2	Initiation commenced	4 February 1998	2-1 = 114
	3	Dissection	20 April 1998	3-2 = 74

Table 2: Day and night temperature conditions (°C) and photoperiod regimes maintained during initiation regimes in the large, controlled-environment cabinets, Experiment 1-5.

Experiment	Glasshouse/ cabinet	Temperature regime		Photoperiod regime
		Day	Night	
1	GH4B1	28	24	12 h 45 min, -30 s/day
	GH4B2	29	25	

	GH6B2	34	25	
2	GH4B1	28	24	12 h 45 min, -30 s/day
	GH4B2	28	24	
	GH6B2	34	26	
	GH8B2	34	26	
3	GH3B1	28	24	12 h 45 min, -30 s/day
	GH3B2	28	24	
	GH6B2	34	25	
	GH8B1	34	25	
4	GH4B1	28	24	12 h 45 min, -30 s/day
	GH4B2	28	24	
	GH6B2	34	24	
	GH8B1	34	24	
5	GH4B1	28	24	12 h 45 min, -30 s/day
	GH4B2	28	24	12 h 45 min, constant
	GH6B2	34	24	12 h 45 min, -30 s/day
	GH8B1	34	24	12 h 45 min, -30 s/day

4.0 RESULTS

Results for the dissections of the three clones from the five experiments outlined above revealed the total failure of the project (Table 3). Not one of 240 meristems dissected had initiated. Although there were minor losses due to death or stress caused by the canopy pushing on the cabinet ceiling, numbers of meristems dissected per clone were almost equal, being 80, 79 and 81, respectively, for the clones H56-752, H70-0144 and 66N2008.

Table 3. Results for Experiment 1-5, given as number of induced meristems/total dissected, for meristem dissections of three sugarcane clones subjected to initiation conditions in two temperature regimes applied in four large controlled-environment cabinets.

Experiment	Glasshouse/ cabinet	Clone		
		H56-752	H70-0144	66N2008
1[1]	GH4B1	0/5	0/6	0/6
	GH4B2	0/8	0/6	0/6
	GH6B2	0/5	0/5	0/6
2[2]	GH4B1	0/4	0/4	0/4
	GH4B2	0/4	0/3	0/4
	GH6B2	0/3	0/4	0/3
	GH8B2	0/4	0/3	0/4
4	GH3B1	0/4	0/4	0/4
	GH3B2	0/4	0/4	0/4
	GH6B2	0/4	0/4	0/4
	GH8B1	0/4	0/4	0/4
4	GH4B1	0/4	0/4	0/4
	GH4B2	0/4	0/4	0/4
	GH6B2	0/4	0/4	0/4
	GH8B2	0/4	0/4	0/4
5[3]	GH4B1	0/4	0/4	0/4
	GH4B2	0/4	0/4	0/4
	GH6B2	0/3	0/4	0/4
	GH8B1	0/4	0/4	0/4

[1] A total < 6 indicated meristems were dead because of stress from growth to the top of the cabinet. A total > 6 indicated meristems in addition to the primary apical meristem were dissected on stalks.

[2] Four meristems were dead because of stress from pressure exerted by growth into the cabinet roof.

[3] One meristem was dead because of stress from pressure exerted by growth into the cabinet roof.

5.0 DISCUSSION

Experiment 1: The objective of the management of the plants was to mimic the growth regime developed at BSES Meringa in BSS58. The plants simply were over fertilised. The Meringa regime used 300 mL of Wuxal diluted in 20 L of water, with 250 mL of the diluted nutrient solution being applied to a 33 L pot at each fertilisation. The Canberra regime used the same dilution, 600 mL to 40 L, with 800 mL being applied to a 16 L pot. This delivered 6.6 times the level of the Meringa regime to a pot at each fertilisation. The effect of this nutrient regime would have been exacerbated somewhat as the trays underneath the pots were not drained weekly, to be refilled with incoming irrigation water. The timing of nutrient applications was in keeping with the Meringa regime. This over-fertilisation was inexcusable because the size relationship of the phytotron and Meringa pots had been discussed, and the adjustment this necessitated to nutrient

applications detailed. Additionally, simply applying a volume of nutrient solution adequate to "wet the surface of the pot" was naive in view of these discussions.

Experiment 2: Plant density per cabinet was reduced from 18 pots (6 replicates x 3 clones), used in Experiment 1, to 12 pots (4 replicates x 3 clones) in this and the remaining experiments. This was done simply to reduce the level of competition among plants within a cabinet. Even though plants were restricted to producing a single culm per pot, plant density was considered excessive, even though the situation was complicated by over fertilisation. The plants were marginally less nitrogen rich in Experiment 2 than in Experiment 1. The slightly modified management given the plants, and the leaching imposed preparatory to the initiation treatment explained this. Stress from well-grown plants simply being too large for the large controlled-environment cabinets again was evident.

Experiment 3: At the time of dissection of Experiment 2 (25 May 1997), plants for Experiment 3 were ready to enter the large controlled-environment cabinets once the pots from Experiment 2 were removed. These plants were much smaller, and considerably less nitrogen rich, than the plants used for Experiments 1 and 2. The prospects of seeing initiated meristems in Experiment 3 were enhanced for these reasons.

The plants were less nitrogen rich than in Experiment 2, and certainly were not as vigorously grown as the previous experiment. However, many stalks were stressed because of excessive growth into the cabinet tops. The internal dimensions of the cabinets are 0.79 m wide x 1.60 m long x 2.44 m high. Special management is required to ensure potted plants of sugarcane can be accommodated within the vertical dimension in these cabinets. The plants in this experiment came closer to this requirement. However, the apical meristems were stressed, as apical dominance was compromised and axillary meristem elongation occurred. This stress probably was sufficient to prevent floral initiation, despite the plants receiving the correct photoperiod regime and being of lower nitrogen status.

Experiment 4: The plants were raised at a lower nutrient status than those in Experiment 3. With the exception of plants in GH8B1, which were accidentally fertilised once about 2 months prior to dissection, plants had not grown into the cabinet roof. Apical meristem dominance over axillary meristems was not lost because of stress imposed from excessive growth into the roofs of the cabinets. A majority of plants in GH8B1 showed axillary meristem development. This resulted from the additional single dose of nutrients that had been given.

Experiment 5: Overall, the plants were raised at a lower nutrient status than those in Experiment 4. Plants in GH6B2, which were accidentally fertilised once, grew to the point where meristems were stressed by pressure exerted on the roof of the cabinet. Some plants in cabinets GH4B1 and GH4B2 also had grown into the cabinet roof.

A major conclusion from this study is that the size of the 'B' cabinets used in the CSIRO phytotron (1.6 m long x 0.79 m wide x 2.44 m high) was inadequate for sugarcane as grown for this research. Despite increasing careful nutrient management through the series of five experiments, growing plants that did not grow excessively, and stress the meristems through pressure against the cabinet tops, proved difficult.

The failure of this project to successfully address the hypothesis was extremely disappointing, given its importance to our understanding of the primary reason for generally poor and variable flowering under natural conditions at BSES Meringa. This failure also limits our ability to specify a natural environment more conducive to operating PFs more than once a year. This is an extremely important consideration in reducing the cost of crosses made from PFs. CSIRO physiologists are puzzled by the failure, because until this experience all plant species they have had in the phytotron were successfully initiated.

Consequently, the hypothesis remains untested. A further attempt to do this is desirable, but should be done in a facility that imposes less, or no physical constraint on the size of plants used in the research. This would make management of the plants easier, and would be more conducive to obtaining a result.

The failure to obtain a single induced meristem in the five experiments conducted is indeed disappointing. We are confident that excessive nutrient provision that marred the conduct of the first two experiments did not influence Experiments 3 through 5. A number of environmental factors could have prevented the plants being induced despite the correct photoperiod being provided.

- The extension lighting could be of the wrong quality or quantity.

  Extension lighting was incandescent, and this is not optimal for sugarcane. Initiation with this lighting is possible but does give lower levels of initiation than obtained with a mixture of fluorescent and incandescent to give a R/FR ratio of 1.4.

  The intensity of lighting also was of concern, with 2 x 100 W bulbs being used per cabinet of floor area of 1.26 m^2 in Experiment 4. This had been upgraded from the 2 x 75 W bulbs used for Experiments 1 through 3. The intention was to increase the lighting intensity for Experiment 5, but this proved impossible because of amperage limits on the electrical circuits for lighting in the cabinets. As well, there may be a shading effect. With only two sources (bulbs) in a controlled cabinet, and with leaves from the canopies being concentrated at the top of a cabinet, distribution of extension illumination may have been very uneven.

- The average plant temperatures may not reflect the average air temperatures imposed because of radiation heating under inadequate airflow conditions.

  Although this is unlikely, this effect is possible. Lower controlled ambient temperatures were provided in Experiment 5, but this was to no avail.

- The plants may be moisture stressed.

This possibility is unlikely, given that the plants were given a maintained water table by keeping trays under the pots while in the initiation phase in the controlled-environment cabinet. The pots still were watered three times daily.

6.0 ASSESSMENT

6.1 Impact

Unfortunately, the potential impact from proving the hypothesis will not be delivered. As mentioned, the knowledge expected to come from successfully verifying this hypothesis would have allowed the possibility of conducting two induction sessions annually in the BSES Meringa PF.

6.2 Cost and potential benefit

The cost of this research is contained in the budget line for the project, and needs no elaboration. The budget was not exceeded because the project was relatively low cost. The potential benefit from the knowledge gained for proving the hypothesis is substantial, and has been adequately covered in the non-technical summary above.

6.3 Future research needs

Proving the hypothesis posed in this project is crucial to improving our understanding of the flower initiation process in sugarcane. If proven, this would allow specification of an environment suitable for operation of PFs more than once year, thus substantially decreasing the unit cost of the outputs from such facilities. Additionally, if proven, such knowledge may allow environmental manipulation of operations of existing facilities to optimise their performance.

7.0 DESCRIPTION OF PROJECT TECHNOLOGY

No technological advances were developed in this project.

8.0 TECHNICAL SUMMARY

Circumstantial evidence available from flowering research conducted at BSES Meringa has implicated high temperature as the major environmental constraint to flower initiation. This was either during the natural initiation period (14 February - 10 March), or during the 60 days of artificial initiation (commencing day length 12 h 45 min, with 30 s/d reduction) in the PF. The objective of the research proposed for project BSS158 was to test the hypothesis that days exceeding 32°C in the initiation period inhibited the flowering process in sugarcane. The research was conducted by invitation in the controlled environment provided by the CSIRO phytotron in Canberra. Potted plants were raised under controlled glasshouse conditions for about 100 d, with the management regime imposed on these supposedly mimicking that developed in earlier research at BSES Meringa. Growth was limited to a single culm per pot. These plants were subjected to initiating conditions in the large shuttered growth cabinets, using two temperature regimes - 28/24°C and 35/25°C. Three clones that had exhibited possible temperature sensitivity

were used. Extension lighting used was incandescent. Two hundred and forty meristems were dissected in five experiments. None had initiated. Over-fertilisation of the plants resulted in excessively lush plants in Experiments 1 and 2. These would have been excessively nitrogen rich and not receptive to initiating conditions even if the meristems were not stressed from pressure exerted by growth of the canopy into the cabinet ceiling. Fertilisation was corrected for the remaining experiments, but even then growth over the average 101 days in the large cabinets was excessive for the cabinet size. Unfortunately, the hypothesis remains untested. The hypothesis still needs to be tested rigorously to advance our knowledge of the flowering process in sugarcane and allow us to manipulate the environment in which existing facilities operate. Specification for location of future facilities also would be possible. These would allow more than one initiation event a year, considerably enhancing the return on investment in such facilities. Rigorous specifications of a facility in which the hypothesis could be tested was the one outcome possible from this project.

9.0 RECOMMENDATIONS

A rigorous test of the hypothesis is required because of its importance to our knowledge of the flowering process and flow-on effects to the crop improvement program. To do this, the following requirements must be met in the facility chosen to conduct the research.

- Precise temperature control will be required both day and night for the hypothesis to be tested rigorously. This will be required for an under-glass environment for daytime conditions to be fully controlled.
- There should be no physical constraint imposed by the facility used that would inhibit the growth of normal, unstressed sugarcane plants for use in this research.
- A “black-box” adjunct to the under-glass environment would best be used for the night environment, the plants alternating between the under-glass (day) and “black-block” (night) environments.
- Extension lighting used in this adjunct should be a mixture of incandescent and fluorescent lighting that conforms to a R/FR ration of 1.4.

10.0 LIST OF PUBLICATIONS

No publications resulted from project BSS158.