Mauritius Research Council

Factors Causing Discolouration of *Anthurium andreanum* Flowers

Final Report

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Mauritius Research Council

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FINAL REPORT OF PROJECT FUNDED BY THE MAURITIUS RESEARCH COUNCIL

FACTORS CAUSING DISCOLOURATION OF *Anthurium andreanum* FLOWERS

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ABSTRACT

A disorder affecting some susceptible varieties of *Anthurium andreanum*, namely **Nitta** and **Mado** has been noticed locally during the summer months of November to February. This disorder has been commonly described as the **Anthurium bleach** and is characterised by a general discoloration or unpigmentation about the lobed (proximal) portion of the spathe. Plants then go into a chronic or long-term symptom stage that is characterised by severe chlorosis and stunting of new leaves. Spathes and spadixes do not develop their normal colour and appear faded, hence the name 'bleaching'.Chronic symptoms usually last for 3 to 6 months or sometimes longer. Locally, it has been noted that there are between 2000 and 5000 unmarketable flowers obtained per month due to **Anthurium bleach**.

The causes of this disorder have not been positively established. Research is still being done, but it is rather slow and difficult because of the inability to reproduce the symptoms under controlled environment. It appears to be a physiological disorder possibly caused by variations in agroclimatic factors such as fertilisation, medium or substrate, shading or light intensity, temperature, water status and relative humidity.It is worth noting that there may be an interaction among these factors especially with respect to the nutrient release patterns.

A trial has been set up in this context with as main objective, the identification of the causes of discolouration of *Anthurium andreanum* flowers .The response of 3 cultivars Nitta, Mado and Tropical has been assessed at three sites in different agroclimatic zones namely Constance, Eau Bleue and Bois Cheri. Top cuttings from 2 to 3 year old parent plants were subjected to a combination of 3 fertiliser and 3 substrate treatments namely:

TSP (250 kg /arp) + CAN (50kg/arp) + 13:13:20:2 (100kg/arp) as top dressing; TSP (250kg/arp)+ CAN (50 kg/arp) and 12: 4: 8 (100 kg/arp) as top dressing; TSP (250 kg/arp) + 13:13:20:2 (150 kg/arp) as top dressing. The media used in this combination were the usual media: soil, bagasse and cinder in the ratio 1: 1: 1; soil, bagasse and poultry manure or soil, bagasse, cinder and actosol. The experiment consisted of 9 treatments and was replicated 3 times with each variety. Observations relating to temperature, rainfall, light intensity inside and outside the shadehouse and relative humidity were taken regularly between the months of August 1999 to May 2000. The plants started to flower in September 1999 and records relating to the flowers were taken thereon.

It was noted that harvested flowers did not show any bleaching symptom in all the 3 sites. This was attributed to the freshness of the substrate which still contained a substantial amount of organic matter hence being capable of retaining moisture and providing good anchorage to the plants. This hypothesis is confirmed when comparing the yield obtained on the different treatments whereby plants on treatments containing organic matter such as poultry manure gave also higher yield of marketable flowers. Flower yield in *Anthurium andreanum* was also seen to be related to cultivar differences and agroclimatic conditions with cultivar Mado best adapted to warm conditions and Nitta and Tropical to cooler conditions. These observations need to be confirmed by continuing observations over the next twelve months. .

TABLE OF CONTENTS

1.INTRODUCTION

This investigation was aimed at identifying the causes of discoloration in *Anthurium andreanum* flowers witnessed in greenhouses around the island. This disorder commonly referred to as **Anthurium bleach** is characterized by a general discolouration and unpigmentation about the lobed (proximal) portion of the spathe. Research is still being carried out in order to establish the causes of this disorder which is believed to be physiological. Factors such as fertilization, medium or substrate, shading or light intensity, temperature and irrigation alone or in interaction have been widely associated with Anthurium bleach (Higaki,1994).Local observations have also lead to the belief that some cultivars are more susceptible to bleach than others. Symptoms may last for up to 6 months and this phenomenon can lead to the monthly loss of some 2000 to 5000 unmarketable flowers in a greenhouse.

This investigation has been carried out in three shadehouses situated at Constance, Eau Bleue and Bois Cheri. The response of three cultivars Mado, Nitta and Tropical (control) to 3 media with different fertilization regimes was monitored. Top cuttings from 2 to 3 year-old parents were used as planting material.

2.TREATMENTS

Three fertiliser treatments were considered:

- the common formulation:-At planting: TSP (250 kg /arp)

  Top dressing:CAN (50kg/arp) + 13:13:20:2 (100kg/arp)

- the common formulation at planting (TSP 250kg/arp)

  CAN (50 kg/arp)and 12 : 4 : 8 (100 kg/arp)as top dressing

- the common formulation at planting(TSP 250 kg/arp)

  13:13:20:2 (150 kg/arp) as top dressing

B. Media

The media investigated were as follows:

- the usual media: soil, bagasse and cinder* in the ratio 1 : 1 : 1
- soil, bagasse and poultry manure
- soil, bagasse, cinder and actosol

3.RESULTS AND DISCUSSION

The measurements and observations taken at the 3 sites during the course of the experiment (August 1999 to May 2000) are detailed and discussed hereunder:

3.1 TEMPERATURE

The mean temperature maxima and minima recorded at the 3 sites during the period of the investigation is illustrated hereunder.

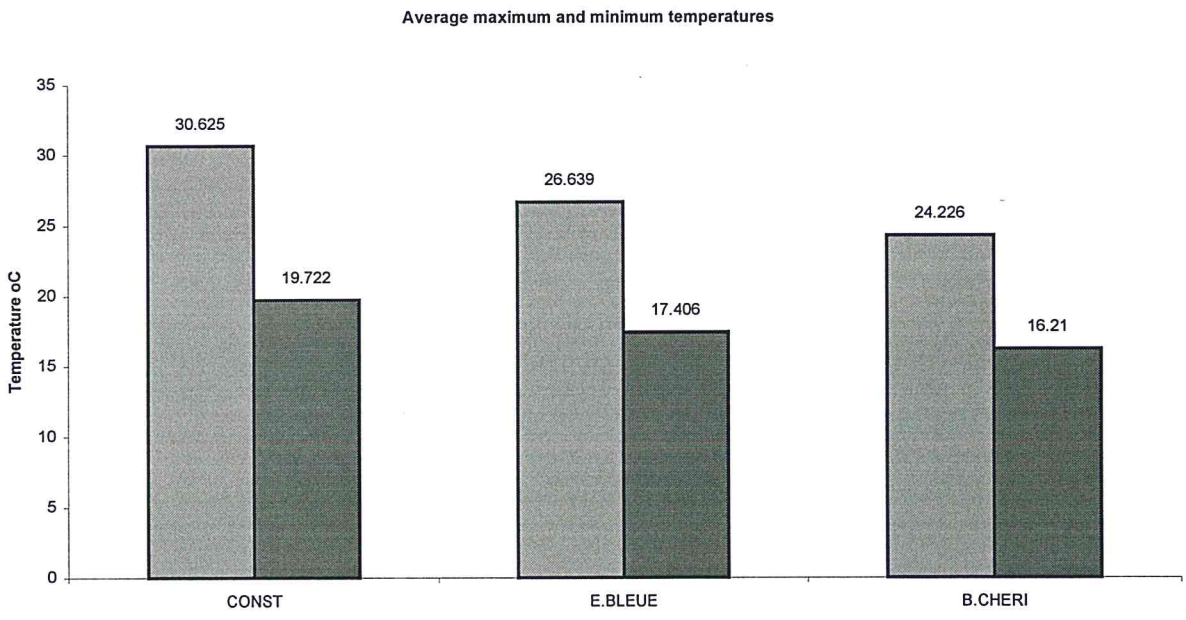


Figure 3.1.Average temperature recorded at the 3 sites

As expected, the mean maximum and minimum temperatures during the period of investigation were higher at Constance, followed by Eau Bleue and Bois Cheri.The impact of temperature on the flowers is well marked when we consider the difference in flower yield at the 3 sites (*section 3.5.2*).As expected, Constance shows a higher yield as compared to Eau Bleue and Bois Cheri; one of the reasons being that the temperature range was optimum for *Anthurium andreanum* only at Constance i.e 20 to 27°C .

3.2 RAINFALL

Observations regarding rainfall during the period of investigations (August1999 to May 2000), are given in figure 3.2 whereby it was noted that a peak in amount of rain was recorded in Bois Cheri in December 1999 after a dry period. Rainfall also increased at the two other sites although less markedly than in Bois Cheri. Nevertheless it was clearly noted that Constance was drier all through the experimental period.

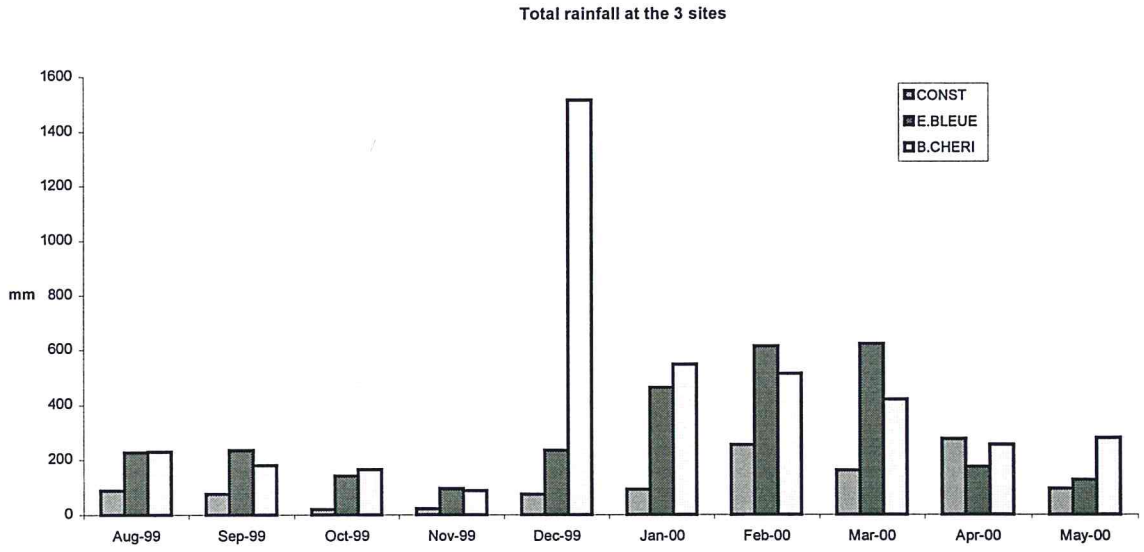


Figure 3.2 Total rainfall at the 3 sites from August 1999 to May 2000

3.3 TEMPERATURE AND HUMIDITY

Figures representing changes in temperature and humidity as annexed( ) indicate that at Constance these two parameters change inversely in winter that is when the temperature increases, the relative humidity decreases inside the shadehouse; the effect is less noticeable in Bois Cheri and Eau Bleue. The relative humidity values in the shadehouses fluctuate between 65% and 95% in Eau Bleue and Bois Cheri but go down to much lower values in Constance (32 to 58%) especially during the dry hot months of October and November. These are values much below the optimum for *Anthurium andreanum* thus subjecting the plants to situational moisture deficit;this is the difference between the absolute moisture content in the substomatal chamber of the stomata and the absolute moisture content in the shadehouse air.

3.4 LIGHT INTENSITY

Light intensity readings were taken both inside and outside the shadehouse at the 3 sites at different times during the day. Literature (Anthura,1998), confirms the shade requirements of anthurium as 65-80% shade providing an ideal radiation of 20,000 to 25,000 Lux inside the greenhouse. Nevertheless, the shade requirements may vary between the cultivars.It can however be noted from figure 3.3 and 3.4 that the shade nets as used in the greenhouses are appropriate but nevertheless, the optimum light intensity for the flowers is only reached during 2 to 3 hours that is between 11 and 13.00hrs at Constance and Eau Bleue.Hence the plants are not receiving their optimum light requirements during most of the day. This probably explains the higher yields obtained at Constance as compared to the two other sites (*fig 3.5.2*).

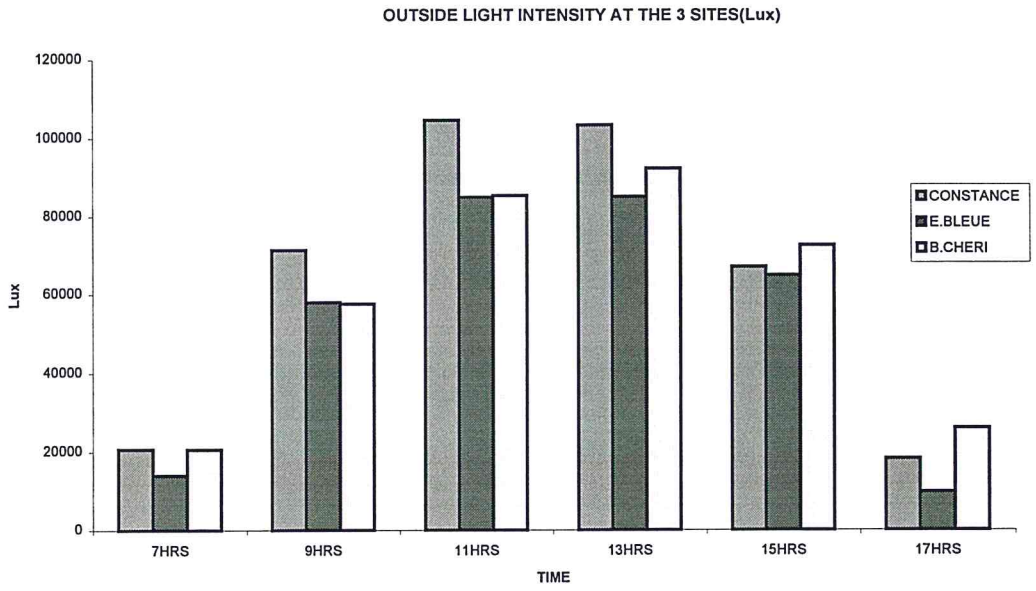


Figure 3.3 Outside light intensity at the 3 sites at different times of the day

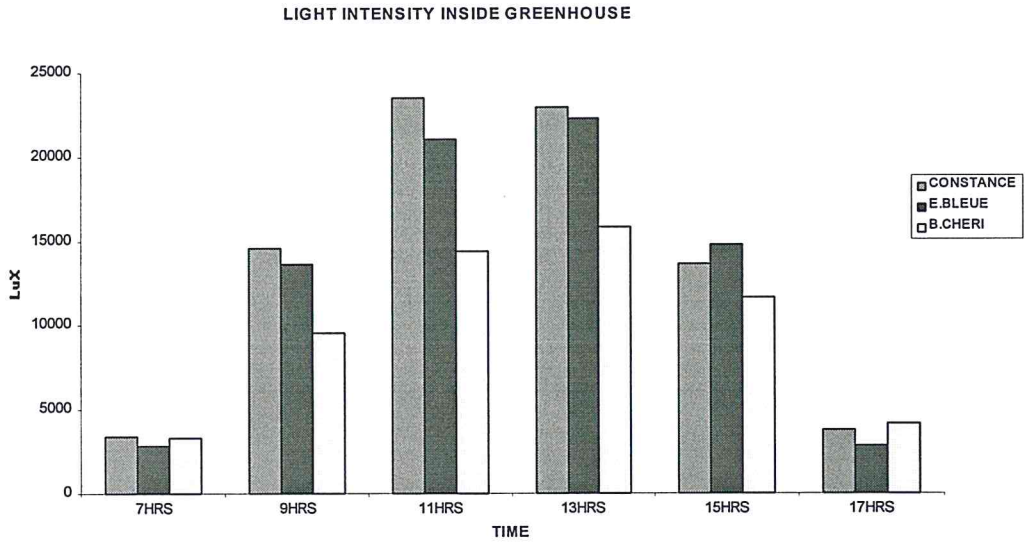


Figure 3.4 Light intensity inside the 3 greenhouses at different times of the day

3.5 FLOWER YIELD

3.5.1 Yield at each site

The yield of flowers over the period of the investigation was recorded for the 3 cultivars and is indicated hereunder:

Table 3.5 Mean values of the yield of flowers obtained at CONSTANCE for the 3 varieties

TREATMENT/ CULTIVAR	F1M1	F1M2	F1M3	F2M1	F2M2	F2M3	F3M1	F3M2	F3M3	TOT
NITTA	33[a]	37	39[a]	42	32	31[a]	32	27[a]	30[a]	303
MADO	49[b]	37	48	49	45	42	42	32	31[a]	375
TROPICAL	48[bc]	36	51[b]	44	43	51[b]	40	45[b]	45[b]	678
TOTAL	130	110	138	135	120	124	114	104	106	

NOTE: Figures followed by different letters within a column are statistically different at P=0.05
Least Significant Difference =13.8

No bleached flowers were obtained at the Constance shadehouse on any treatment. Analysis of variance (*annex 1*) has shown that there were differences in yield between the 3 cultivars but that the different treatments did not affect the yield. Hence it could be deduced that the differences in yield was due only to cultivar differences at Constance. Tropical and Mado seem to be performing better at Constance than Nitta but Tropical being the best adapted variety for this region.

Table 3.6 Mean values of the yield of flowers obtained at EAU BLEUE for the 3 varieties

TREATMENT/ CULTIVAR	F1M1	F1M2	F1M3	F2M1	F2M2	F2M3	F3M1	F3M2	F3M3	TOT
NITTA	27	24[a]	31[a]	32	37[a]	36[a]	31[a]	38[a]	32	288
MADO	22	24[a]	19[b]	27	26[b]	24[b]	27[b]	27[b]	30	226
TROPICAL	15	12[b]	26	26	25[bc]	23[bc]	25[bc]	25[bc]	30	207
TOTAL	64	60	76	85	88	83	83	90	92	

NOTE: Figures followed by different letters within a column are statistically different at P=0.05
Least Significant Difference= 9.37

At Eau Bleue, yields were also statistically different between the cultivars and yield between treatments were also different. However, no bleaching was noted. Nitta seemed to be performing much better in those treatments than Mado and Tropical at Eau Bleue. With respect to media, analysis of variance and least significant differences have shown better total yields in F2M2 and F3M2 than other treatments at 95% significance level. In general it seemed that M2 substrates containing additional organic matter such as poultry manure as used in the experiment have a beneficial effect on yield as compared to the other substrates under test.

Table 3.7 Mean values of the yield of flowers obtained at BOIS CHERI for the 3 varieties

TREATMENT/ CULTIVAR	F1M1	F1M2	F1M3	F2M1	F2M2	F2M3	F3M1	F3M2	F3M3	TOT
NITTA	28[a]	22	20	17	24	16	26[a]	21	20	194
MADO	18[b]	18	17	16	18	24	15[b]	22	16	161
TROPICAL	12	14	19	19	21	19	16[bc]	15	17	162
TOTAL	68	54	56	52	63	56	57	58	53	

NOTE: Figures followed by different letters within a column are statistically different at P=0.05

Least Significant Difference=8.82

Key:F1: Common formulation(TSP 250 kg/arp at planting) + Top dressing (CAN 50kg/arp+13:13:20:2 100kg/arp)

F2: Common formulation (TSP 250kg/arp at planting) + Top dressing (CAN (50 kg/arp + 12 : 4 : 8(100kg/arp)

F3: Common formulation (TSP 250 kg/arp planting + Top dressing (13 : 13 : 20 : 2 (150 kg/arp)

M1: Usual medium: soil, bagasse and cinder

M2: Soil, bagasse and poultry manure

M3: Soil, bagasse, cinder and actosol (100 kg/arp)

Statistical analysis using the analysis of variance have also shown that different cultivars perform differently at Bois Cheri although variations in treatments did not seem to affect performance. Cultivar Nitta seemed to be performing better at Bois Cheri than Mado and Tropical on all treatments.

3.5.2 Total flower yield at the 3 sites

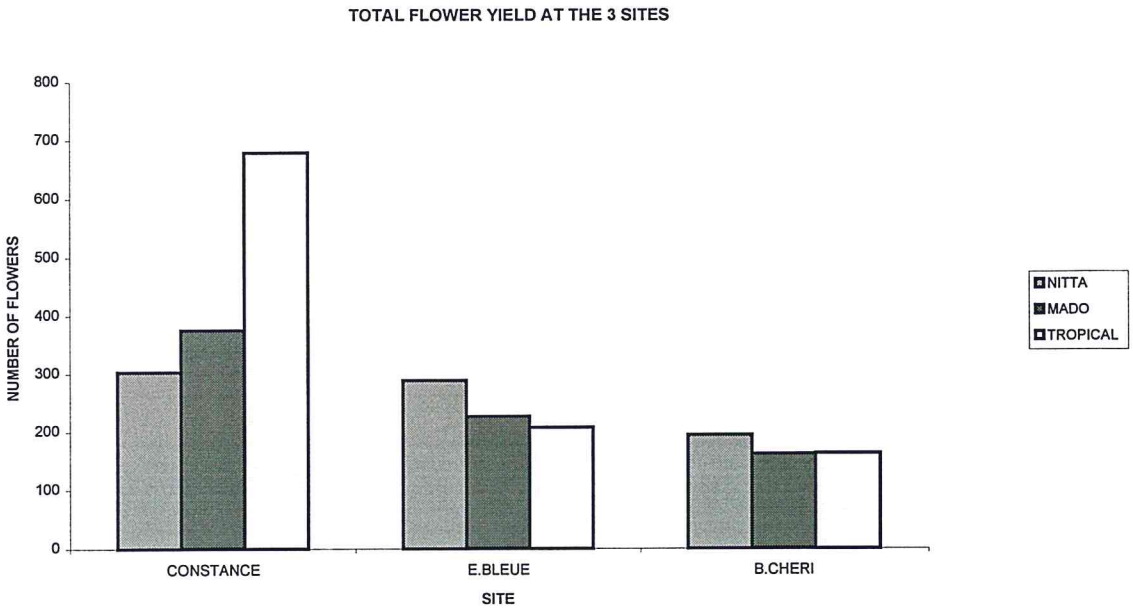


FIGURE 3.5 TOTAL YIELD OF FLOWERS AT THE 3 SITES FROM AUGUST 1999 TO MAY 2000

It can be deducted from the above figure that the performance of the different cultivars depends on the location of the shadehouse. All other conditions being equal that is substrate, treatments and cultural practices, the only variables remaining relate to the climatic conditions: temperature, relative humidity, rainfall and light intensity inside the shadehouses.
Cultivar Tropical seems more adapted to the warmer conditions of Constance, Nitta performs better in cooler regions of Eau Bleue and Bois Cheri.

3.6 GENERAL DISCUSSION AND CONCLUSION

No bleaching was observed in any of the treatments at the 3 sites. Hence records relate to the number of marketable flowers only. The fact that no bleaching was observed could be due to several reasons but nevertheless one reason could be that the planting material was still young and the substrate fresh. Records have shown that the disorder appears at later

stages in the life of the plant when the substrate has lost its water retention capacities due to prolonged periods of dry conditions resulting in decrease in organic content. Hence we might need to continue observations as to the occurrence of bleaching of *Anthurium andreanum* flowers.

Given that we did not witness any bleaching in the flowers and that treatment effects did not have any significant effect of yield and bleaching except for Eau Bleue on F2M2 and F3M2, other parameters such as yield of flowers on the different treatments at the various locations were analysed. Hence it could be deduced that:

1. The cultivars vary with respect to their performance and this is related to the climatic conditions; Tropical being well adapted to warmer conditions of Constance where other factors such as light intensity and temperature are also higher inside the greenhouse although the optimal light intensity (20,000-25,000Lux) is reached only 2 to 3 hours during the day.

2. It is well established that Anthuriums thrive better when temperatures range between 18°C and 27°C (Higaki,1994).However , according to our observations, the mean temperature ranges were below those values at Eau Bleue and Bois Cheri during the period under test(*fig 3.1*) .This factor could also be responsible for the lower yields of flowers at these sites.

3. The fact that irrigation was provided at Constance shadehouse where bleaching is usually observed leads to the conclusion that water stress and relative humidity are critical factors when considering the occurrence of Anthurium bleach as reported by several authors (Higaki, 1994).

4. As the experiment has been performed using very young top cuttings from 2 year old plants and a fresh substrate, there is a need to continue making observations for at least another year on all treatments at the 3 sites to observe if there is any bleaching with time. This would provide enough time to allow the plants to adapt to the substrates under test and responding to them.

3.7 REFERENCES

Higaki T., Litchy JS., Moniz D (eds),(1994)."*Anthurium culture in Hawai"* .Research Extension Series/ Hawai Innstitute of Tropical Agriculture and Human Resources .

Anthura, (1998).Cultivation Guide Anthurium. Anthuriumweg 14, ,BV Bleiswijk, Holland.

ANNEX 1

ANALYSIS OF VARIANCE AT CONSTANCE ON THE DIFFERENT TREATMENTS

Anova: Two-Factor Without Replication

SUMMARY	*Count*	*Sum*	*Average*	*Variance*
Row 1	9	303	33.66667	22.5
Row 2	9	375	41.66667	48.5
Row 3	9	403	44.77778	23.94444
Column 1	3	130	43.33333	80.33333
Column 2	3	110	36.66667	0.333333
Column 3	3	138	46	39
Column 4	3	135	45	13
Column 5	3	120	40	49
Column 6	3	124	41.33333	100.3333
Column 7	3	114	38	28
Column 8	3	104	34.66667	86.33333
Column 9	3	106	35.33333	70.33333

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows	591.4074	2	295.7037	13.83709	0.000324	3.633716
Columns	417.6296	8	52.2037	2.442808	0.061099	2.591094
Error	341.9259	16	21.37037			
Total	1350.963	26				

(LEAST SIGNIFICANT DIFFERENCE) L.S.D = 13.8

ANNEX 2

ANALYSIS OF VARIANCE AT EAU BLEUE ON THE DIFFERENT TREATMENTS

Anova: Two-Factor Without Replication

SUMMARY	*Count*	*Sum*	*Average*	*Variance*
Row 1	9	288	32	21
Row 2	9	226	25.11111	10.61111
Row 3	9	207	23	33
Column 1	3	64	21.33333	36.33333
Column 2	3	60	20	48
Column 3	3	76	25.33333	36.33333
Column 4	3	85	28.33333	10.33333
Column 5	3	88	29.33333	44.33333
Column 6	3	83	27.66667	52.33333
Column 7	3	83	27.66667	9.333333
Column 8	3	90	30	49
Column 9	3	92	30.66667	1.333333

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows	398.7407	2	199.3704	18.13221	7.71E-05	3.633716
Columns	340.963	8	42.62037	3.876211	0.010154	2.591094
Error	175.9259	16	10.99537			
Total	915.6296	26				

L.S.D = 9.37

ANNEX 3

ANALYSIS OF VARIANCE AT BOIS CHERI ON THE DIFFERENT TREATMENTS

Anova: Two-Factor Without Replication

SUMMARY	*Count*	*Sum*	*Average*	*Variance*
Row 1	9	194	21.55556	15.52778
Row 2	9	161	17.88889	5.361111
Row 3	9	162	18	7.25
Column 1	3	68	22.66667	25.33333
Column 2	3	54	18	16
Column 3	3	56	18.66667	2.333333
Column 4	3	52	17.33333	2.333333
Column 5	3	63	21	9
Column 6	3	56	18.66667	6.333333
Column 7	3	57	19	37
Column 8	3	58	19.33333	14.33333
Column 9	3	53	17.66667	4.333333

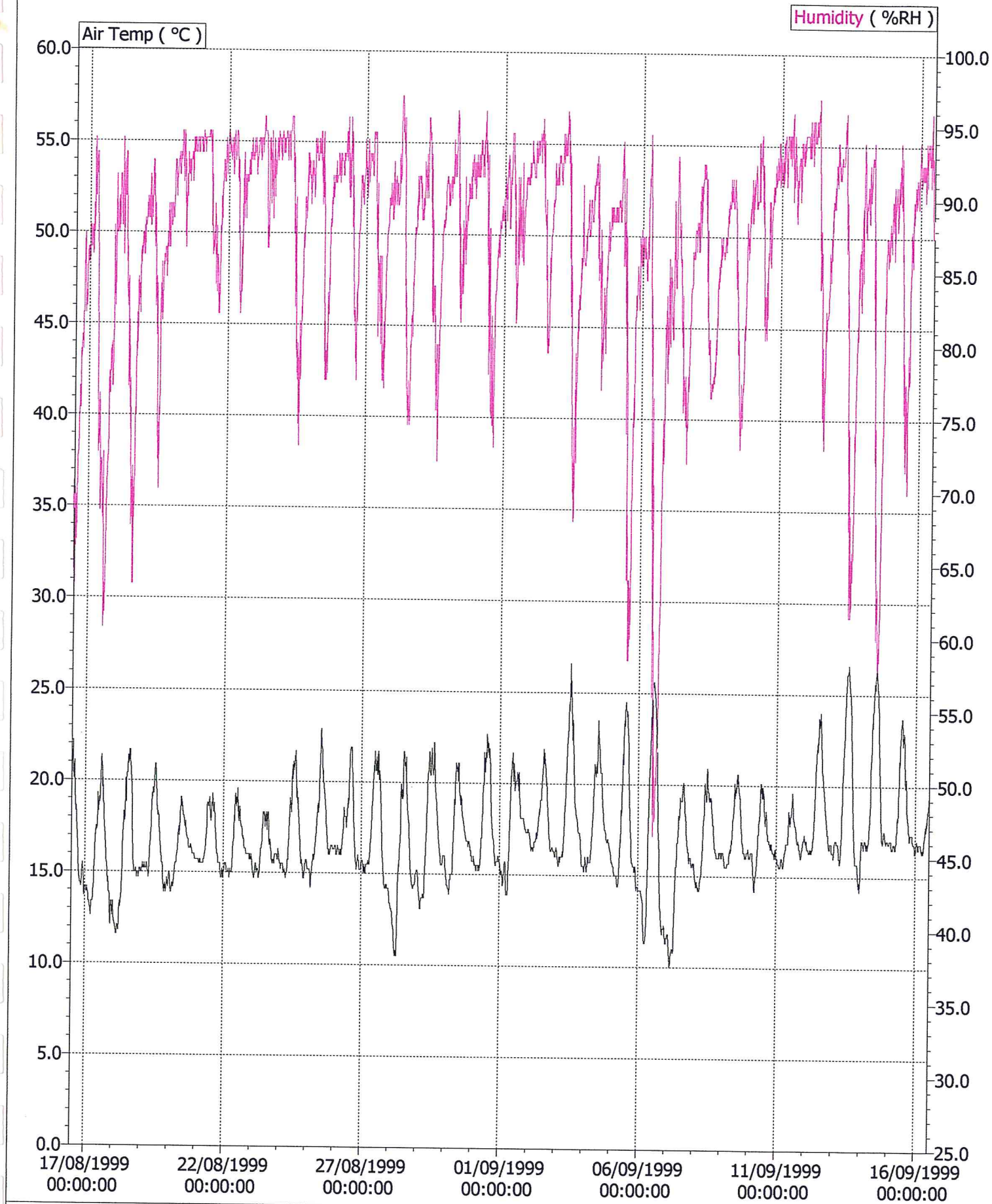
ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows	78.2963	2	39.14815	4.022835	0.038429	3.633716
Columns	69.40741	8	8.675926	0.891532	0.545141	2.591094
Error	155.7037	16	9.731481			
Total	303.4074	26				

L.S.D = 8.823

ANNEX 4

TEMPERATURE AND RELATIVE HUMIDITY RECORDS AT BOIS CHERI AND CONSTANCE



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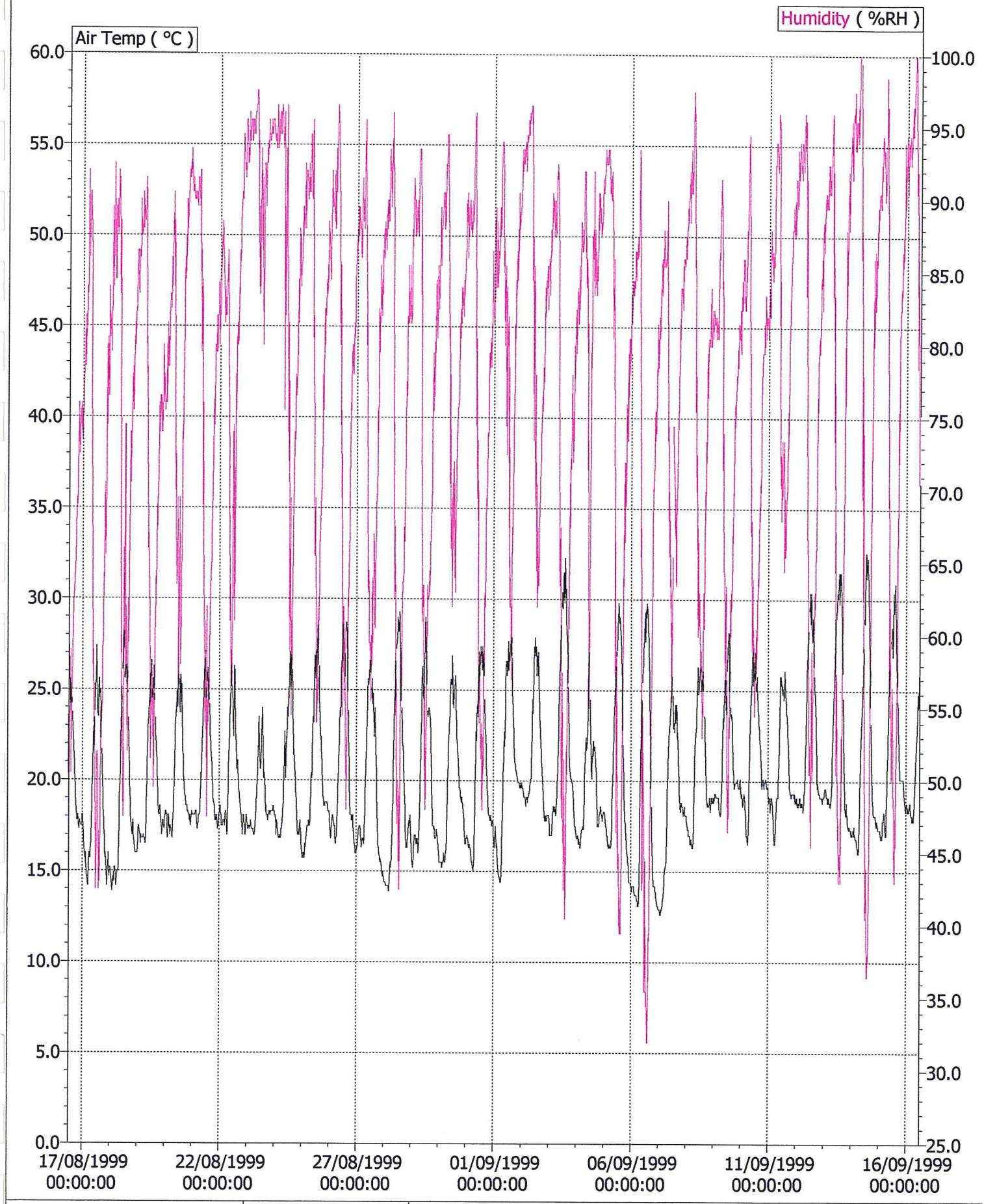

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