Effects of Duct-type Pad and Fan on Temperature Reduction and Eustoma Quality II

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1. Introduction

A duct-type pad and fan (hereinafter referred to as "duct-type P&F") was introduced last year as a heat control measure in the No. 9 greenhouse at the International Academy of Horticulture, and Mr. Watanabe of the Flower Cultivation Course demonstrated its effect on temperature reduction and the quality of Eustoma.

However, the humidity inside the duct-type P&F equipment did not rise sufficiently, and the cooling effect of the ducted P&F was not fully achieved, leaving the quality improvement of Eustoma and soil disease control as issues to be addressed.

2. Purpose of Study

This year, additional tests were conducted to address the remaining issues from the previous year: (1) improving cooling efficiency, (2) improving the quality of Eustoma, and (3) soil disease control.

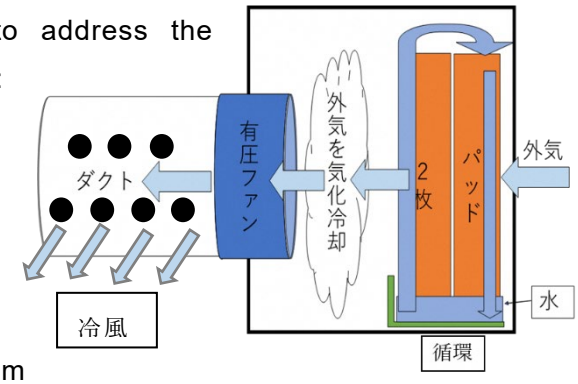

図-1 ダクト式 P&F の仕組み図

3. Method of Study

(1) Duct-type P&F System and Improvements

As shown in Figure 1, the duct-type P&F system cools the outdoor air by passing through a moistened cooling pad, and then the air is sent by a fan through the duct to cool the plants. At this time, one more 10cm thick cooling pad was added to improve cooling efficiency.

(2) Installation of Isolated Beds

The isolated beds were used to prevent the outbreak of a wilt disease caused by Fusarium fungi, a soil disease that caused problems last year.

(3) Method of Temperature Reduction Effect Study

For the temperature reduction effect study, as shown in Figure-2, thermometers were installed in the outdoor airspace, inside the P&F equipment, in the test area, comparison area on May 18, 2023, and temperature transitions were investigated. In addition, humidity transitions were also investigated in the outdoor air and inside the P&F equipment.

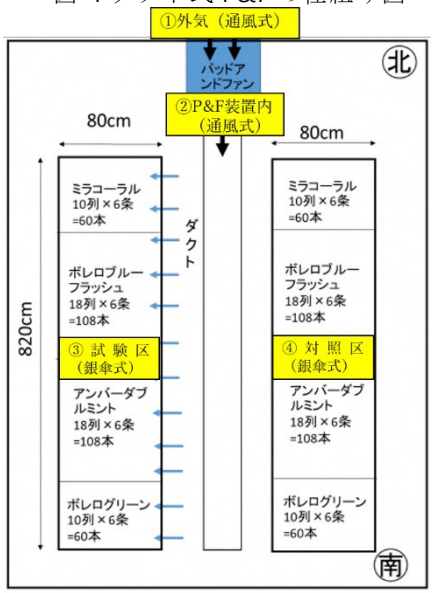

図-2 試験区及び対照区の設置

(4) Method of Eustoma harvest survey

Fifteen plants each of Bolero Blue Flash, Amber Double Mint, and Bolero Green shown in Figure-2 were investigated for height, weight, and number of flowers (number of blooming flowers and bud) at the time of harvest in the test and comparison areas.

4. Results and Observations

(1) Result of Temperature Reduction Effect Survey

The temperature reduction effect study is as shown in Figure-3. At 14:20, when the outdoor temperature was at its highest on this day, the outdoor temperature was 36.0℃, the temperature inside the P&F equipment was 30.5℃, and the humidity was 48.1% in the outdoor air and 71.1% within the P&F equipment, resulting in a -5.5℃ temperature and +23.0% humidity within the P&F equipment compared to the outdoor air.

In addition. last year's result that the temperature within the P&F equipment was -2.5 ℃ and the humidity was +14.0% compared to the outdoor air shows the doubling of cool pads increased the humidity within the P&F equipment and improved the cooling efficiency.

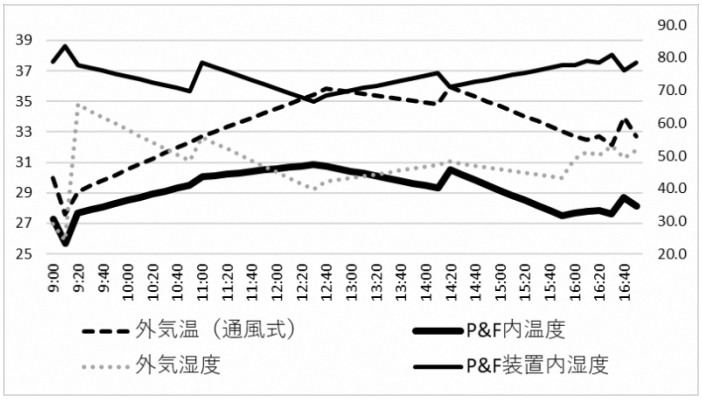

図-3 晴天高温時（7 月 6 日）の温度・湿度推移

However, we received advice from Professor Shimazu of Gifu University's Faculty of Applied Biological Sciences that the cooling effect could be further enhanced by further increasing the sealing rate of the P&F equipment.

Comparison of the maximum temperature transition from June 27 to July 2 between the test and comparison areas shows that the test area was -2.4 to -5.4℃ lower than the comparison area, -3.4℃ lower on average, as shown in Figure-4. Since the average temperature in the test area was -2.4℃ lower than that in the test area last year, the temperature reduction effect was improved by -1.0℃ compared to last year.

(2) Results of Harvest Survey of Eustom

As shown in Tables 1 and 2, the height of "Bolero Blue Flash" and "Bolero Green" were 2.7 cm and 4.0 cm higher, respectively, in the test area, while "Amber Double Mint" was 1.8 cm higher in the

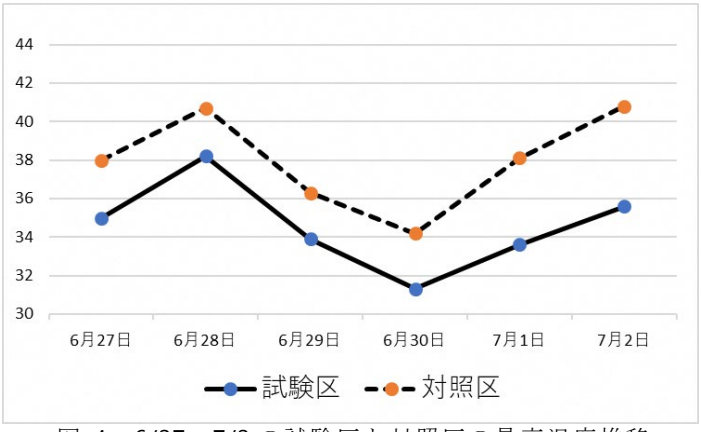

図-4　6/27～7/2 の試験区と対照区の最高温度推移

comparison area.

The weight of "Amber Double Mint" and "Bolero Green" were 1.3 g and 3.2 g heavier, respectively, in the test area, and "Bolero Blue Flash" was 2.8 g heavier in the comparison area.

The number of flowers was 0.5 more for "Bolero Blue Flash," 0.8 more for "Bolero Green" in the test area, while the "Amber Double Mint" had 0.5 more flowers in the comparison area.

Thus, the harvest survey results showed no significant differences between the test and comparison areas. This is thought to be the result of reduced water irrigation this year to prevent tip burn and softening of the flower stalks, as the isolated beds made it easier to control the amount of water irrigation.

表-1 ユーストマの収穫調査結果（草丈・重さ）

	草丈			重さ		
品種	試験区A	対照区B	差A-B	試験区A	対照区B	差A-B
ボレロブルーフラッシュ	54.1	51.4	+2.7	27.8	30.6	-2.8
アンバーダブルミント	58.4	60.2	-1.8	39.3	38.0	+1.3
ボレログリーン	67.0	63.0	+4.0	42.2	39.0	+3.2

表-2 ユーストマの収穫調査結果（輪数）

	輪数						
	試験区			対照区			
品種	花	蕾	合計A	花	蕾	合計B	合計の差A-B
ボレロブルーフラッシュ	1.9	2.2	4.1	1.9	1.7	3.6	+0.5
アンバーダブルミント	1.9	2.8	4.7	2.1	3.1	5.2	-0.5
ボレログリーン	4.0	4.4	8.4	4.5	3.1	7.6	+0.8

(3) Effect of isolated beds

As for the installation of isolated beds, last year, approximately 30% of the plants died from wilt disease due to soil-borne diseases, but this year, none of the 90 surveyed plants died.

(4) Future Issues

From this survey, the following issues remain to be addressed: (1) Improvement of P&F equipment sealing ratio (2) Review of water irrigation methods to improve quality. I would like to increase the cooling effect of P&F equipment by improving these issues, which will lead to the enhancement of the quality of Eustoma.

Translation of Figures and Tables

図-1 ダクト式 P&F の仕組み図
Figure-1 Duct-type P&F System
冷風
Cool Air
有圧ファン
Pressurized Fan
外気を気化冷却
Evaporative Cooling of Outdoor Air
パッド 2 枚
2 Pads
外気
Outdoor Air
循環
Circulation
水
Water
ミラコーラル
‘Mira Coral’
ボレロブルーフラッシュ
‘Bolero Blue Flash’
アンバーダブルミント
‘Amber Double Mint’
ボレログリーン
‘Bolero Green’

図-2 試験区及び対照区の設置
Figure-2 Installation of Test and Comparison Areas
①外気（通風式）
Outdoor Air (ventilated)
②P＆F 装置内（通風式）
Within the P&F Equipment (ventilated)
③試験区
Test Area
④対照区
Comparison Area
10 列×6 条＝60 株
10 Rows x 6 Strips = 60 Plants
北

North
南
South
パッドアンドファン
Pad and Fan

図-3 晴天高温時（7 月 6 日）の温度・湿度推移
Figure-3 Transition of Temperature and Humidity on Sunny and Hot Days (July 6)
外気温（通風式）
Outdoor Air Temperature (ventilated)
外気湿度
Outdoor Air Humidity
Ｐ＆Ｆ内温度
Temperature within P&F
Ｐ＆Ｆ装置内湿度
Humidity within P&F Equipment

図-4　6 月 27 日～7 月 2 日の試験区と対照区の最高温度推移
Figure-4 Transition of Maximum Temperature in the Test and Comparison Areas from June 27th to July 2nd

表-1 ユーストマの収穫調査結果（草丈・重さ）
Table-1 Eustoma Harvest Survey Results (grass height and weight)
品種
Variety
試験区
Test Area
対照区
Comparison Area
差
Difference

表-2 ユーストマの収穫調査結果（輪数）
Table-2 Eustoma Harvest Survey Results (number of flowers)
花
Flower
蕾
Bud
合計
Total

合計の差
Total Difference