Effect of a Simple Evaporation Cooling Device for Cutting Propagation in Arid Lands©

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The United Arab Emirates (UAE) is a desert country with annual rainfall of 100 mm where the maximum temperature in May to September is 35 to 45°C, and the minimum temperature is 20 to 25°C. In such arid condition, an evaporative-cooling system is effective in plant production. The capability of evaporation cooling is almost the same as the differential of dry bulb and wet bulb.

The system is even more effective inland. Inland, 100 km from shore, the air temperature is above 40°C and the relative humidity is below 20%, so the air temperature inside of the greenhouse with a cooling system is about 30°C. In UAE, the pad and fan cooling system is widely used in greenhouses. However, in large greenhouses used for vegetable and flower production, there is a large difference in temperature and humidity between the end with the cooling pad and the end with the fan. For example, in a greenhouse 30 m long, the temperature differential is more than 10°C.

The pad and fan cooling system currently used has several problems in the UAE, namely the high costs for the facilities and the wasting of a limited natural water resource. In order to eliminate the above problems and enable year-round propagation of cuttings, a device equipped with mist nozzles in a tunnel enclosed by a nonwoven fabric was developed and tested on an experimental basis. Changes in air temperature, relative humidity, and rooting conditions of the cuttings subjected to this misting treatment were compared with other enclosed systems and a control (Fig. 1). The results of cutting propagation in the systems are shown in Table 1. Changes in the air temperature and relative humidity on 15 June are shown in Fig.2.

The results were as follows: (1) The use of enclosure-mist device was effective for the preservation of cuttings in arid lands. (2) Temperature in the enclosured-mist

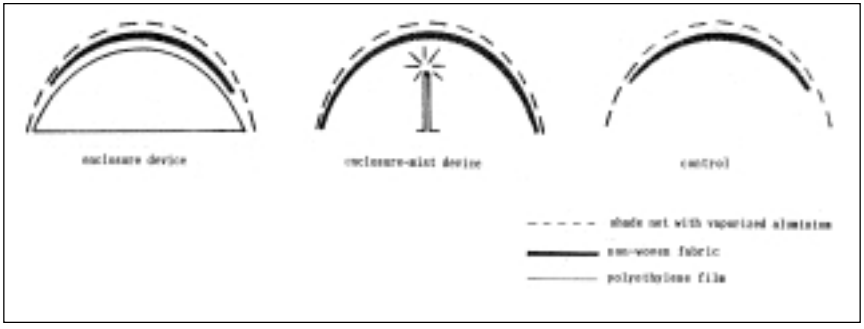

Figure 1. Schematic diagram of three devices for cuttings.

Table 1. Effects of use of enclosure and enclosure-mist devices on the rooting of cuttings

Species	Device	Watering method	Cuttings (No.)	Survival (%)	Rooted cuttings (%)	Roots per cutting	Dry weight (mg) of roots per cutting
Bougainvillea	enclosure	no watering	72	80.6 b	83.3 a	20.4 a	313 a
	enclosure-mist 12	1 min/h, 12 sprays	72	100.0 a	87.5 a	28.8 a	431 a
	enclosure-mist 3	1 min/4h, 3 sprays	72	97.2 a	88.9 a	24.1 a	504 a
	control	Watering 3 times/week	72	100.0 a	84.7 a	20.1 a	489 a
Clerodendron	enclosure	no watering	40	82.5 a	70.0 a	10.7 a	88 a
inerme	enclosure-mist 12	1 min/h, 12 sprays	40	92.5 a	45.0 b	4.0 b	8 c
	enclosure-mist 3	1 min/4h, 3 sprays	40	95.0 a	57.5 ab	4.5 b	23 b
	control	Watering 3 times/week	40	27.5 b	7.5 c	0.1 c	0 c

Different letters within a column at each species show a significant difference by Duncan's multiple range test at p=0.05.

device was close to the wet-bulb temperature by mist spraying for 1 min and was maintained for about 40 min.

It was concluded that the theory of evaporation cooling is easy to apply to simple devices. And the enclosure-mist device is suitable for cutting propagation in summer in arid lands. However, further studies should be carried out on the effect of the structure and thickness of the nonwoven fabric, size of mist particles, and frequency of mist spraying on the maintenance of stable temperature and humidity conditions in the enclosured-mist structure.

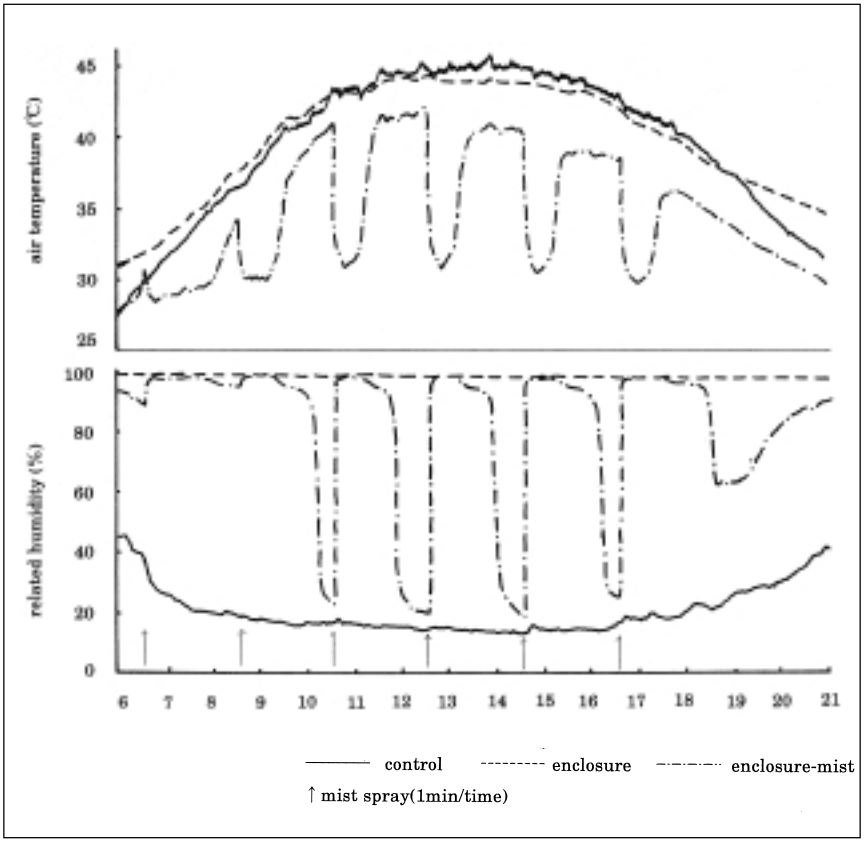

Figure 2. Changes in air temperature and relative humidity in enclosuer, enclusure-mist 6 and control devices for cutting form 6:00 to 21:00 on June 15.