The Effects of the Physical and Chemical Properties of Growing Media on the Growth of Herbaceous Flowering Plants in Cell-Tray Culture

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INTRODUCTION

The cell-tray culture of flowering plants is increasing in Japan and many kinds of media designed for this type of culture are now on sale. Overseas, many growing media have been investigated (Baker,1957; Bunt, 1988) and their physical and chemical properties and effect on plant growth have been clarified (Fontano and Nelson, 1990; Sonneveld, 1990; Biernbaum,1992; Lang,1994). On the other hand, an investigation of Japanese media has not been carried out and their effects on the growth of flowering plant seedlings are unknown. We produced nine media (Table 1), by mixing six commercial media, and investigated the effective volume (%) of pore space for air capacity and NO_3 content of the media.

MATERIALS AND METHODS

The nine media had three water-content levels in the range pF0 to pF1.0 water tension which correlates to pore space, each at three NO_3-content levels. The minimum levels of phosphorus and potassium in the media were adjusted to 60 and 100 mg per 100 g dry weight, respectively, by the addition of superphosphate and potassium.

Table 1. Design of physical and chemical properties of the media.

Medium no.	Water content	NO_3 content (mg per 100 g)
1	7.2	75
2	7.2	115
3	7.2	154
4	11.4	75
5	11.4	115
6	11.4	154
7	14.5	75
8	14.5	115
9	14.5	154

On 7 July 1997 we sowed 30 seeds of vinca (*Catharanthus roseus* G. Don) 'Flash', *Petunia* 'F1 Telster', geranium (*Pelargonium*) 'F1 Pink', marigold (*Tagetes erecta* L.) African tall marigold, cosmos (*Cosmos bipinnatus* Cav.) 'Parade', and *Impatiens* Super Elfin hybrid in cell trays (128 cells).

RESULTS AND DISCUSSION

Of the three water content levels, the fresh weight of the whole plant and shoot length for vinca, geranium, and marigold were highest in the 11.4% medium. Petunia, cosmos, and impatiens were highest in the medium with 14.5% water content. Growth in the 7.2% water content medium was inferior to others in shoot fresh weight and shoot length.

Table 2. Effect of water content of media between pF0 to 1.0 on the growth of plants (mean of five plants).

Organ	Water content (%)	Vinca	Petunia	Geranium	Marigold	Cosmos	Impatiens
Plant F.W.	7.2	0.64 g	0.69 g	1.11 g	1.70 g	0.66 g	0.65 g
(g)	11.4	0.87 g	0.74 g	1.27 g	2.58 g	0.61 g	0.66 g
	14.5	0.59 g	1.29 g	1.15 g	1.61 g	0.79 g	0.87 g
Shoot	7.2	5.7	5.7	5.1	13.9	15.5	2.9
length	11.4	6.1	5.9	5.9	18.7	12.4	2.7
(cm)	14.5	6.1	7.2	5.8	16.1	15.3	3.2
Number of	7.2	7.6	7.5	6.5	8.0	8.0	8.7
leaves	11.4	7.7	8.5	6.7	6.9	7.5	11.6
	14.5	7.9	9.1	6.8	8.9	14.7	14.7

Among the NO_3 media levels tested, the heaviest fresh weight with marigold was obtained in the 75 mg 100 g^{-1} medium, geranium was in the 115 mg 100 g^{-1} and cosmos was in the 154 mg 100 g^{-1}. No significant differences were observed between the various NO_3 levels on the growth of vinca, petunia, and impatiens.

There was an interactive effect between the water levels and NO_3 levels to leaf fresh weight, i.e. vinca, geranium, tagetes, and cosmos were significantly heavier in the 11.4% water content medium with 115 mg 100 g^{-1} NO_3 content as opposed to the 7.2% with 75 mg 100 g^{-1} medium.

These results indicate that a medium containing about 11.4% water in the range of pF0 to pF1.0 with an NO_3 content of 115 mg 100 g^{-1} is suitable for plant growth in cell trays. In general, a soil water content in the range pF0 to 1.0 relates closely to the drainage and air capacity of the soil, and the NO_3 content in the medium is very important to the nutrient condition of the plant and also relates to pH, EC, and leaching of base in the medium.

Therefore, it is important when making media for use in cell trays, to aim for air capacity and NO_3 content in the range indicated.

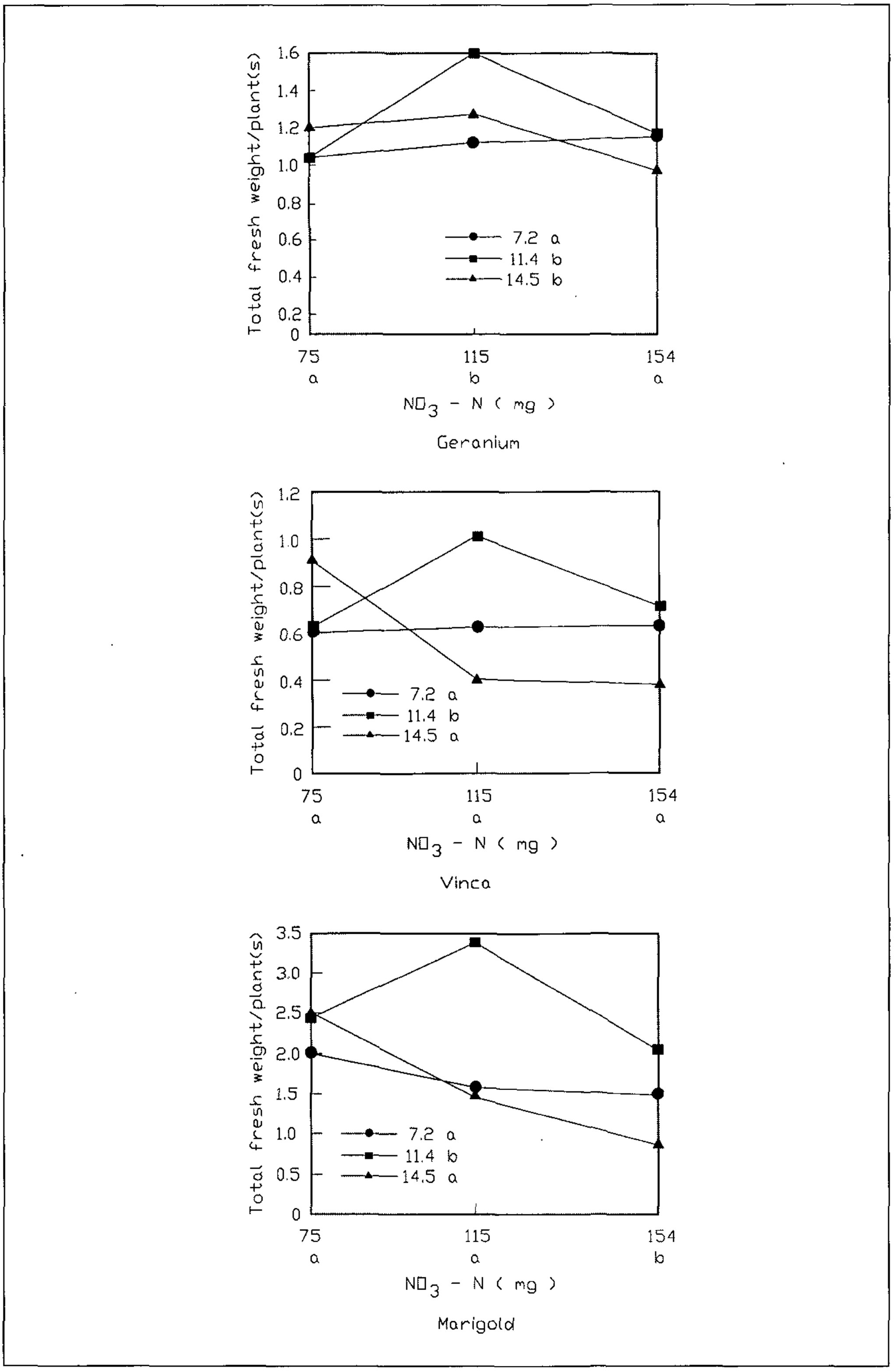

Figure 1. Effect of water content and NO_3 content in media on fresh weight of leaves (mean of fine plants). Different letters indicate significant differences by Duncan's multiple range test at 5% level.

Table 3. Effect of NO_3 content in media on the growth of plants (mean of five plants).

Organ	NO_3 content (%)	Vinca	Petunia	Geranium	Marigold	Cosmos	Impatiens
Plant F.W.	75	0.72	1.07	1.09	2.22	0.58	0.73
(g)	115	0.77	1.06	1.33	2.15	0.59	0.77
	154	0.62	0.69	1.11	1.49	0.89	0.77
Shoot	75	4.3	6.3	5.2	15.9	11.1	3.1
length	115	6.2	6.6	6.2	17.4	14.9	2.9
(cm)	154	5.8	5.9	5.4	15.4	17.2	2.8
Number of	75	8.3	8.2	6.6	9.2	5.8	11.6
leaves	115	7.8	8.5	6.8	8.9	8.3	12.5
	154	7.2	8.5	6.7	8.3	9.2	10.9

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