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Sabine Altmann*, Armin Blievernicht, Stefan Irrgang, Heiner Grüneberg

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*Corresponding Author:

Sabine Altmann
Humboldt-Universität zu Berlin
Landwirtschaftlich-Gärtnerische Fakultät
Lehr- und Forschungsgebiet Gärtnerische Pflanzensysteme
AG Zierpflanzenbau, FG Ökophysiologie der Pflanzen
Germany
Email: altmanns@hu-berlin.de

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Effects of *Sphagnum* in growing medium on the postharvest quality of *Euphorbia pulcherrima*

Sabine Altmann, Armin Blievernicht, Stefan Irrgang, Heiner Grüneberg

Humboldt-Universität zu Berlin, Landwirtschaftlich-Gärtnerische Fakultät, Lehr- und Forschungsgebiet Gärtnerische Pflanzensysteme, AG Zierpflanzenbau, FG Ökophysiologie der Pflanzen, Germany

1. Introduction, Knowledge, Objectives

In professional horticulture, the most important substrate component is white peat. In Germany, only one third of the demanded three to four million m^3 a^{-1} can be covered by local cutting while the rest must be imported. Stocks of white peat in West- and Middle Europe are nearly depleted and peat cutting is assumed to cause negative impacts on climate changes and biodiversity. Furthermore, prices for alternatives such as wood byproducts have been increasing due to their usage for bioenergy (Gaudig et al. 2008; Falkenberg 2008). As a result, research for alternative growing media constituents is mandatory.

Due to its unique physical and economical characteristics, an adequate alternative for peat is still missing. However, *Sphagnum*, the precursor of peat, was yet successfully applied for the cultivation of orchids (Emmel 2008). In addition, both the extraction of peat moss by *Sphagnum* farming and the usage of peat moss as growing media constituent was investigated (Emmel 2008). The cultivation of ornamental plants in *Sphagnum* was generally successful but its effectivity varied with the different *Sphagnum* species used (Emmel 2008). Also, the suitability of cultivation of *Euphorbia pulcherrima* in two *Sphagnum* species was examined (Altmann 2009). It was shown that the development of poinsettias was not negatively affected if cultivated in growing medium containing up to 75 % *Sphagnum* material of both species (Altmann 2009).

Shelf life of poinsettias, which are among the economically most valuable floriculture plants in the world, is highly influenced by the growing medium (Steinbacher and Hauser 1999; Clifford et al. 2004). However, nothing is known about the keeping quality of poinsettias in retail and after sale.

To analyse shelf life of poinsettias, growing in substrates of both *Sphagnum* species, plants were cultivated for further 16 weeks post production. Particularly two questions should be answered: 1. Has the *Sphagnum* concentration in the substrate any effect on keeping quality of plants? 2. Do the *Sphagnum* species used influence long-term substrate quality?

2. Material and Methods

Preparation of *Sphagnum* substrates and cultivation of *Euphorbia pulcherrima* was described in detail earlier (Altmann 2009). In brief, *Sphagnum palustre* and *Sphagnum*

fallax, collected in the field, were air-dried for three weeks and sieved to a fraction of less than 20 mm. Bulk density (DIN EN 13040) of the standard growing medium was 280 g L^{-1} that of *Sphagnum palustre* 25 g L^{-1} and *Sphagnum fallax* 36 g L^{-1}, respectively. Standard poinsettia growing medium (Typ, Klasmann-Deilmann GmbH, Geeste, Germany) was replaced by 0 %, 25 %, 50 %, 75 %, 100 % of *Sphagnum palustre* and *Sphagnum fallax* (Bechstein et al. 2010).

Uniform (height 4 cm; diameter 3.5 cm; root ball size 3.5 cm x 3.5 cm; 9 – 12 leaves) young plants (270) of poinsettia ´Cortez` (Syngenta Agro GmbH, Maintal, Germany) were transplanted into pots (12 cm, 500 ml), containing standard medium or various *Sphagnum* substrate mixtures, initially fertilised (N = 160 mg L^{-1}, P_2O_5 = 120 mg L^{-1}, K_2O = 200 mg L^{-1}, Mg = 110 mg L^{1}). Randomly placed in three blocks with ten plants for every treatment, poinsettia were grown in a glasshouse (climate: setpoint 20 ± 1 °C; mean RH 60 %; radiation transmission 30 %) on flood-floor under ambient light and photoperiod conditions in Berlin, Germany at an initial density of 49 plants m^{-2}. They were pinched to six nodes two weeks after potting and spaced to a final density of 9 plants m^{-2} and weekly fertilised with 0.2 % of Wuxal® super solution (Wilhelm Haug GmbH & Co. KG, Düsseldorf, Germany). In calendar week 37 the plants received one application of chlormequat chloride at 80 ml (concentration: 0.3 %).

Plant height (above substrate surface) and diameter (average of biggest and smallest diameter at site branches showed equal length) was measured every second week. At the end of experiment, aerial plant parts were harvested and weighed (fresh mass), dried to constant mass at 150 °C and weighed again (dry mass). For statistical analyses ANOVA was performed and significance of differences between means ($n = 30$; $p < 0.05$) was tested by Tukey multiple comparison test (SPSS for windows 11.5.1, IBM corporation, Armonk, New York, U.S), No significant differences between *Sphagnum* grown plants at either treatment and control medium grown poinsettias on either measured parameters was found, except for plant height in 100 % *Sphagnum fallax* (Altmann, 2009).

For shelf life experiments, 135 (five per block) plants were cultivated for 16 weeks according to VBN (2005; cf. Altmann 2012) and fertilised with Wuxal® (0.2 %; 100 ml) during the initial five weeks. Afterwards, the quantity was reduced to 50 ml for three weeks, during the last six weeks no fertiliser was applied. Number of lost leaves per plant was scored weekly. These leaves were tallied up at the end of the test. Furthermore, contents of nitrogen and phosphate in the substrates as well as fresh and dry mass of the aerial parts of the plants were determined like in the previous trial. Also, the number of cyathia was counted, including closed ones larger than three millimetres. From top view images, diameter and red-to-green ratio of all leaves per plants were calculated using WinCam 2007d (Regent Instruments, Inc., Quebec, Canada). Images were taken with an Olympus E-410 (Olympus Deutschland GmbH, Hamburg, Germany), fixed on a tripod and provided with a white rectangle (1 cm x 1 cm). For the red-to-green ratio, the most typical colours of background and foreground, i.e. bracts and leaves, had to be defined; then, cluster of similar shades of colours and colour areas were calculated. As a result, the area of the whole plant as well as the red-to-green ratio was obtained as percentage of the whole plant. Furthermore, the diameter of the plants could be calculated from the colour area with $d = 2(A/Pi)^{1/2}$ by summing both colours (Regent Instruments, 2007). For statistical analyses ANOVA was performed and significance of differences between means ($n = 15$; $p < 0.05$) was tested by Tukey multiple comparison test (SPSS for windows 11.5.1, IBM corporation, Armonk, New York, U.S). Means were compared according to *Sphagnum* quantities and *Sphagnum* species. The results of the latter are not shown in this article.

3. Results

After 16 weeks, all poinsettias showed still the same high quality as at the beginning of the shelf life experiment, irrespective of the substrate used. However, plants cultivated in 75 % and 100 % *Sphagnum* substrate had started to grow askew (Fig. 1).

Fig. 1: Images of the same plant of *Euphorbia pulcherrima* grown, in 75 % *Sphagnum palustre* substrate, before and after 16 weeks of shelf life test.

Total dry mass of plants did not significantly differ between poinsettias grown in the different *Sphagnum fallax* mixtures and those cultivated in the control medium. In contrast, plants grown in 50 %, 75 % and 100 % *Sphagnum palustre* media had a significantly higher total dry mass.
To analyse the potential effects of the different substrates on the external quality of plants, i.e. their appearance, red-to-green ratio (area of bracts and leaves respectively in comparison to total plant) and the plant diameter were investigated. The diameter of the plants growing in the *Sphagnum* mixtures did not significantly differ from those cultivated in standard poinsettia medium. Diameter of poinsettias in the 75 % *Sphagnum palustre* substrate was even markedly bigger. Increasing amounts of *Sphagnum*, however, reduced the red-to-green ratio. In the 75 % and 100 % *S. fallax* substrate, the red-to-green ratio was significantly smaller than that of the plants in the control. Apart from that, no other significant, negative effect of the different *Sphagnum* substrates on any other quality parameter was measured (Table 1).

Table 1: Means of various quality parameters of *Euphorbia pulcherrima* ´Cortez` grown in *Sphagnum* substrates after 16 weeks of shelf life.

Sphagnum species	rate [%]	Leaf drop [pcs]			Diameter [cm]			Cyathia [pcs]			Fresh mass [g]			Dry mass [g]			Red-to-green ratio [%]		
		Mean	SD	Ind. [2)]	Mean	SD	Ind. [2)]	Mean	SD	Ind. [2)]	Mean	SD	Ind. [2)]	Mean	SD	Ind. [2)]	Mean	SD	Ind. [2)]
S. palustre	0 [1)]	18.7	± 9.2	a	24.1	± 1.7	bc	13.6	± 6.5	a	119.0	± 9.2	c	19.2	± 2.3	c	90.3	± 5.1	a
	25	24.9	± 15.0	a	22.8	± 1.8	c	6.6	± 6.9	a	119.1	± 18.1	c	20.0	± 4.2	bc	89.6	± 2.0	a
	50	17.9	± 7.0	a	24.5	± 1.2	ab	9.9	± 6.4	a	127.2	± 13.0	bc	21.3	± 1.7	b	88.1	± 2.6	a
	75	14.5	± 4.8	a	26.2	± 1.6	a	13.2	± 8.5	a	151.0	± 20.2	a	25.5	± 4.3	a	86.8	± 4.1	a
	100	15.9	± 8.5	a	25.7	± 1.3	ab	12.9	± 8.5	a	143.5	± 15.3	ab	23.5	± 2.3	a	87.0	± 5.8	a
S. fallax	0 [1)]	18.7	± 9.2	a	24.1	± 1.7	a	13.6	± 6.5	a	119.0	± 9.2	a	19.2	± 2.3	a	90.3	± 5.1	a
	25	17.2	± 13.1	a	24.9	± 2.0	a	13.7	± 8.8	a	126.7	± 14.8	a	21.1	± 3.2	a	89.4	± 3.5	a
	50	23.3	± 14.6	a	24.3	± 0.9	a	12.4	± 5.1	a	123.0	± 13.3	a	20.2	± 2.4	a	88.0	± 3.5	ab
	75	22.0	± 11.2	a	24.3	± 1.2	a	9.4	± 8.4	a	117.2	± 13.3	a	20.7	± 3.3	a	83.8	± 4.5	bc
	100	14.4	± 8.1	a	24.4	± 2.1	a	12.2	± 8.6	a	124.0	± 21.0	a	21.2	± 3.1	a	82.0	± 5.1	c

Given are means ± standard deviation (SD)

[1)] 0 % proportion indicates controls on standard poinsettia medium.

[2)] Differing letters denote significant differences between means (Tukey multiple comparison test, n = 15, $p < 0.05$)

To reveal a potential connection between the nutrient contents and the plant development a substrate analysis was carried out. The more *Sphagnum* the growing media contained, the higher nitrogen and phosphate content was detected. Nutrient content (mg/100 g substrate):
N in control = 0.363; in *S. palustre*: 25% = 0.391; 50% = 0.828; 75 % = 1.151; 100% = 1.670; in *S. fallax*: 25 % = 0.531; 50% = 0.613; 75 % = 1.356; 100 % = 1.939. P in control = 22.27; in *S. palustre*: 25% = 35.11; 50% = 65.02; 75 % = 93.56; 100% = 299.433; in *S. fallax*: 25 % = 46,79; 50% = 69.19; 75 % = 163.53; 100 % = 259.92.

4. Discussion

This study clearly demonstrated that cultivation of *Euphorbia pulcherrima* plants in *Sphagnum* substrates of various mixtures did not at all negatively affect postharvest quality up to moss concentrations of 50 %. Beyond that the red-to-green ratio and, hence, the external quality, i.e. the attractiveness of plants, may decrease.
This decrease in the colour appearance at high substrate concentrations of *Sphagnum* moss may be related to the increasing nitrogen and phosphate contents of the growing media. It was shown earlier that high concentrations of nitrogen and phosphate promote vegetative growth of poinsettias, thereby reducing the red-to-green ratio (Grantzau and Iken 1999; Degen and Koch 2009).
The partial significant enhancement of the total plant dry mass with increasing *Sphagnum* proportion in the growing media may also be attributed to the rising nitrogen content of the substrates. Consequently, optimisation of fertiliser application during cultivation and, most of all, during shelf life, would balance the amounts of nutrients.
Further, the effect that plants growing in media containing more than 50 % *Sphagnum* became lopsided during the 16 weeks may be attributed to the lower bulk density of *Sphagnum* in comparison to the control medium. This may lead to an aggravated sagging of the substrates at high *Sphagnum* proportions (Blievernicht 2012), resulting in a lower stability of the plants. Generally lopsided growth largely reduces the attractiveness of poinsettias, thus, downgrading their postharvest quality. Densification of *Sphagnum* mixtures during potting might increase the stability of plants.
From the above it has become clear that *Sphagnum* is, at least partly, suitable for the cultivation of poinsettia. On the other hand, the pivotal question must be raised as to what extent *Sphagnum* is available as horticultural growing media constituent on a large scale. Furthermore, it is yet not studied in detail, whether it will be accepted as a peat substitute. According to Bechstein et al. (2010), the development of suitable cultivation methods, which assure availability of sufficient raw material and a successful introduction of *Sphagnum* as growing medium on the market should be subjected to further research. Moreover, producers of growing medium are cautious concerning replacement of peat to a great extent. Growers were concerned that *Sphagnum* could fit the criteria for a good growing medium but may not work with current management practices. They furthermore stated that a growing medium with an assured quality and quantity, available at a competitive price and reliable for all intents and purposes will be preferred.

5. Conclusions

In this study, growth of poinsettias on media with the different *Sphagnum* quantities did not have significant, negative effects on any measured quality parameter except the decrease in the red-to-green ratio. It could, therefore, be concluded that both *Sphagnum fallax* and *S. palustre* are suitable for the cultivation of *Euphorbia pulcherrima*. At least, up to a content of 50 % in the growing media, it can be used without reservation regarding postharvest quality. Both peat mosses were likewise applicable with slight advantages of *S. palustre*. However, a lot of research will still be necessary to successfully introduce *Sphagnum* as a large scale growing medium constituent.

6. Literature

Altmann, S. (2009): Untersuchung zum Einfluss von *Sphagnum* in Topfpflanzensubstraten am Beispiel von *Euphorbia pulcherrima*. Bachelor's thesis, Lehr-und Forschungsgebiet Gärtnerische Pflanzensysteme, AG Zierpflanzenbau, Landwirtschaftlich-Gärtnerische Fakultät, Humboldt-Universität zu Berlin

Altmann, S. (2012): Effects of *Sphagnum* in pot plant soil on the postharvest quality of *Euphorbia pulcherrima*. Master's thesis, Lehr-und Forschungsgebiet Gärtnerische Pflanzensysteme, AG Zierpflanzenbau, Landwirtschaftlich-Gärtnerische Fakultät, Humboldt-Universität zu Berlin

Bechstein, F., Blievernicht, A., Gorbachevskaja, O., Grüneberg, H., Häbler, J., Richter, M. (2010): Verbundprojekt moosfarm: Torfmooskultivierung auf schwimmenden Vegetationsträgern für ein nachhaltiges und umweltfreundliches Torfsubstitut im Erwerbsgartenbau, Teilvorhaben: *Sphagnum* farming in der Tagebaufolgelandschaft – Abschlussbericht, released April 2010, Verein zur Förderung agrar- und stadtökologischer Projekte e. V. (ASP)

Blievernicht A., Irrgang S., Zander M., Ulrichs C. (2012): Kultivierung von *Calluna vulgaris* in torfreduzierten *Sphagnum*-Substraten. DGG-Proceedings 2 (1): 1-5. DOI: 10.5288/dgg-pr-02-01-ab-2012

Clifford, S.C., Runkle, E.S., Langton, F.A., Mead, A., Foster, S.A., Pearson, A., Heins, R.D. (2004): Height Control of Poinsettia Using Photoselective Films. 2004. Hort Science 39(2):383-387.

Degen B., Koch R. E (2009): N-Bedarfswert von 800 mgN/Pfl. für Poinsettien (Mehrtrieber) wurde bestätigt. Versuche im deutschen Gartenbau, LVG Heidelberg. http://www.hortigate.de/bericht?nr=44127 (Latest access 6 June 2013)

Emmel, M. (2008): Growing ornamental plants in *Sphagnum* biomass. Acta Horticulturae 779: 173-183.

Falkenberg H. (2008): Torfimporte aus dem Baltikum. Bedeutung für die Torf- und Humuswirtschaft in Deutschland. Bergbau 3/2008: 132 – 135.

Gaudig G., Joosten H., Kamermann D. (2008): Growing growing media: the promises of *Sphagnum* biomass. Acta Horticulturae 779: 165-171.

Grantzau E., Iken T. (1999): Phosphatversorgung von *Euphorbia pulcherrima* in verschiedenen Substraten. Versuche im deutschen Gartenbau, LVG Hannover-Ahlem. http://www.hortigate.de/bericht?nr=8004 (Latest access 6 June 2013)

Steinbacher F., Hauser B. (1999): Haltbarkeit von *Euphorbia pulcherrima* in Holzfaser- und Torfsubstraten unter verschiedenen Bewässerungsbedingungen. Versuche im deutschen Gartenbau, TUM Weihenstephan, Lehrstuhl für Zierpflanzenbau, http://www.hortigate.de/bericht?nr=35564, (Latest access 6 June 2013)

VBN (2005): VBN standard sales simulation for cut flowers. P.O. Box 9324, 2300 PH Leiden, The Netherlands.