ACTA AGROBOTANICA
Vol. 53, z 1 – 2000
s. 23-30

Use rockwool as a substrate for *Peperomia obtusifolia*, *Streptocarpus hybridus* and *Spathiphyllum floribundum*

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(Received: 8.02.2000)

Summary

Two experiments were conducted, in which the granulated rockwool 'Grodan', utilised rockwool 'Flormin', used before as slabs and remained after 2-year carnation culture (UR) - shredded and steamed and two kinds of insulation rockwool of domestic production: from Gliwice (RG) and from Nidzica (RN) were used as a substrate or its ingredient for mentioned in title plants. Particular plant species expressed somewhat diversified reaction, but generally rockwool showed full usability as a substrate or its component. The best kind appeared to be UR. RG was good in the mix, where it was in 25% of the volume, but RN was unsuitable.

Key words: growing medium, substrate, rockwool, pot plants, *Peperomia obtusifolia*, *Streptocarpus hybridus*, *Spathiphyllum floribundum*

INTRODUCTION

Creating the optimal conditions for root growth is an important task in pot plant cultivation. Dominating factor deciding about these conditions are the physical properties of growing medium, mainly its air-water relations. Very different compounds can be mixed together in order to achieve the best medium properties for specific plant species and growing technics. However, pot plants used to be grown mostly in universal substrates (containing peat, perlite or vermiculite, sometimes sand, bark or another components) (Brown and Emino, 1981; Poole and Conover, 1986; Burghardt and Ellering, 1987 and others). There are some rules that should be complied in their preparation (Bunt, 1976; Nelson, 1998). Most important is to provide enough air-filled porosity in order to permit gas exchange to and from roots. Materials recommended for improving the porosity include bark, expanded clay, granulated rockwool, coir etc.

Leidenfrost and Elgner (1985) tested several commercial substrates for poinsettia. All except one bark-based substrate proved suitable, but the best was one containing rockwool. Lee et al. (1987) used loose rockwool in comparison with peat-lite and soil-based medium for growing poinsettia. They obtained good quality plants in all media, but heavier fresh and dry weight was in soil-based medium. Contrisciano and Holcomb (1995) used two types of hydrophilic mineral wool either alone or in combination with peat moss for pot and bedding plants. One of them performed well - used alone or with peat amendment, the other one was better if used with 25-75% peat amendment. Granulated rockwool 'Grodan' is recommended by a manufacturer as a good loosening amendment, improving aeration of growing media (Anon., 1992).

The aim of this study was to estimate the suitability of different kinds of rockwool used as a pure substrate, in combination with peat or as an amendment together with another components in some pot plants cultivation.

MATERIALS AND METHODS

Two similar experiments were conducted: Exp.1 - in years 1992/93 and Exp. 2 - in 1994/95. In both experiments bare rooted cuttings of *Peperomia obtusifolia* 'Variegata' were planted into 11 cm plastic pots (700 cm^3) at the beginning of July and plantlets of *Streptocarpus hybridus* obtained from leaf cuttings - into 9 cm pots (350 cm^3) at the same time. *Spathiphyllum floribundum in vitro* propagated plantlets with 2-4 leaves of 1.5-3 cm length were planted in Exp.1 into 8 cm pots (300 cm^3) at the end of June and transplanted into 11 cm pots on February next year. In Exp.2 *Spathiphyllum* plants were bigger: they had 3-5 leaves of 3-4 cm length, came from trays and were planted directly into 11 cm pots.

Following components were used to compose the growing medium:

- Water absorbent granulated rockwool 'Grodan' (WaR)
- Water repellent granulated rockwool 'Grodan' (WrR)
- Utilised rockwool 'Flormin', used before as slabs and remained after 2-year carnation culture (UR) - shredded and steamed
- Sphagnum peat (P)
- Perlite (Pe)
- Composted pine bark (B)
- Sand (S)
- Granulated rockwool from Gliwice (RG)
- Granulated rockwool from Nidzica (RN)

The last two kinds of rockwool were the insulation, water repellent materials of domestic production. In the following text the mixed substrates used in particular combinations will be referred to abbreviations of components.

The growth media studied were rockwool alone or two- or four-component mixtures, combined in even volumetric proportions as specified in Tables 1-3, except the control combination, which was peat+perlite 3:1. All media except shredded rockwool were brought to pH 6.5-7.0 and amended with fertiliser to NPK level ($mg.dcm^{-3}$): 150 ($N\text{-}NO_3$: $N\text{-}NH_4$ = 2:1), 60 and 280 respectively by means of potassium nitrate and ammonium phosphate. Shredded rockwool was similar in levels of

pH and nutrients except P, which was 410 mg·dm^{-3}. Microelement salt mix in common proportion was also added in level of 0.1 g·dcm^{-3}. Adequate supply of Mg was achieved by irrigation water containing 25 mg Mg in 1 liter and by top fertilisation. One month after planting the regular subsequent fertilisation was started with use of complete fertilisers in hydroponic concentrations and was performed with each watering. There were 6 replications (plants) in each combination for *Peperomia* and *Spathiphyllum* in both experiments, and for *Streptocarpus*: 7 - in Exp. 1 and 9 - in Exp. 2. *Streptocarpus* was grown through 10 months in Exp.1 and 9 months in Exp.2, other plants - through 13-15 months all in the greenhouse conditions.

At the end of each experiment the data reflecting plant size or growth and flowering characteristics were collected and commercial quality was evaluated (Tables 1-3).

RESULTS AND DISCUSSION

Peperomia was growing well in all growth media (Table 1). The final plant size was bigger in Exp. 1 than in Exp. 2, but the results of both experiments proved the full suitability of rockwool as a substrate or its ingredient. Crown diameter (mean of two cross dimensions) in Exp.1 was biggest, when old utilised rockwool (UR) alone was used, in Exp. 2 - when granulated rockwool from Gliwice (RG) in 4-component mixture was used. Total shoot length of one plant depended similarly on growing medium in both experiments, however two best groups of media could be more clearly distinguished. These groups were: media containing UR and 4-component media with rockwool. Fresh weight did not differ from this much, but in both experiments rockwool alone appeared to give heaviest plants. Rockwool from Nidzica (RN) performed significantly worse. Small response of this plant to the growth medium was found also in another research, however the best usually occurred the medium containing quite high level of water absorbent fraction (B r o w n and E m i n o, 1981; C o n o v e r and P o o l e, 1986; M c C o n n e l l and S h i r a l i p o u r, 1991).

Table 1.

Growth characteristics of *Peperomia* obtusifolia as influenced by growing media containing rockwool

Growing medium	Plant diameter (cm)		Total stem length (cm)		Fresh weight of upper plant part (g)	
	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II
Control (P+Pe :1)	36.7 ab*)	48.6 ab	194 ab	296 ab	483 a	870 ab
WaR	41.5 bcd	50.0 abc	248 ab	292 ab	729 d	1094 b
UR	43.5 d	49.3 abc	261 b	359 bc	719 d	1085 b
WrR+P	37.8 abc	45.3 a	234 ab	274 ab	627 bcd	934 ab
UR+P	42.8 cd	52.8 abc	240 ab	332 bc	679 cd.	1053 ab
RN+P	40.0 a-d	46.2 a	212 ab	249 a	568 abc	828 a
WrR+P+B+S	37.0 ab	49.4 abc	220 ab	334 bc	577 abc	975 ab
UR+P+B+S	37.8 abc	55.1 bc	219 ab	382 c	559 abc	1010 ab
RN+P+B+S	37.6 abc	52.8 abc	209 ab	334 bc	545 abc	931 ab
RG+P+B+S	34.3 a	56.8 c	184 a	388 c	488 ab	930 ab

Explanations:
*) Means with the same letter do not differ significantly according to the Duncan's range test at 5% level

Streptocarpus produced the highest number of leaves in 4-component medium containing RG or UR in Exp.1 and in UR+P in Exp.2 (Table 2). Total leaf length was biggest, when plants were grown in UR in Exp.1 and in UR+P in Exp.2. Plants in Exp.2 produced much more leaves than in Exp.1, but they were smaller. Flowering was more abundant in Exp.1 and differences between substrates were mostly not significant (except RN+P, where the number of inflorescences was lower). In Exp.2 the

Table 2.

Growth characteristics of *Streptocarpus hybridus* as influenced by growing media containing rockwool

Growing medium	Number of leaves		Total leaf length (cm)		Number of inflorescences		Fresh weight of upper plant part (g)		Quality evaluation (1-5)	
	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II
Control (P+Pe :1)	5.5 abc*)	22.1 bc	132 ab	261 bc	18.1 b	4.1 bc	76 b	64 b	4.0 b	3.1 b
WaR	5.0 a	27.5 cd	138 abc	342 cde	21.9 b	14.3 f	111 bc	163 d	4.7 b	5.0 d
UR	6.2 abc	24.9 bcd	242 e	363 de	26.1 b	10.1 ef	121 c	195 d	4.1 b	5.0 d
WrR+P	6.8 abc	18.6 b	207 de	238 b	21.7 b	6.3 cd.	115 c	72 b	4.8 b	3.4 bc
UR+P	6.1 abc	32.6 d	179 bcd	418 e	23.6 b	17.1 f	110 bc	170 d	4.3 b	4.8 d
RN+P	5.1 a	7.6 a	88 a	73 a	8.5 a	1.0 a	41 a	17 a	2.5 a	1.5 a
WrR+P+B+S	6.3 abc	19.8 bc	176 bcd	238 b	26.8 b	8.3 de	95 bc	79 bc	4.3 b	3.4 bc
UR+P+B+S	7.2 bc	23.5 bcd	190 cde	265 bc	24.8 b	11.0 ef	107 bc	96 bc	4.3 b	4.1 cd
RN+P+B+S	5.3 ab	10.6 a	98 a	95 a	18.2 b	2.9 ab	36 a	21 a	2.3 a	1.6 a
RG+P+B+S	7.3 c	27.5 cd	154 bcd	307 bcd	24.4 b	12.7 ef	85 bc	107 c	3.9 b	4.1 cd

Explanations:
*) Means with the same letter do not differ significantly according to the Duncan's range test at 5% level

flowers were most numerous when plants were grown in UR+P. Fresh weight was biggest in UR in both experiments. Regardless of different growth and flowering habit in particular experiments (due probably to different genotypes and perhaps to some extent also to different climatic conditions) it looks quite clearly, that the best growth medium was rockwool alone ('Grodan' and 'Flormin') and their mix with peat, but 4-component medium was definitely worse. Such effect can be also noticed in quality score. It is in some contradiction with statement of F i s c h e r and H e n t i g (1981) who found, that Oasis (polyurethane foam) and Grodan (rockwool) substrates were unsuitable for *Streptocarpus* hybrid Constant Nymph. In all growth and quality parameters the media containing RN gave worse results, control substrate was also usually worse than those with good results.

There were no significant differences in *Spathiphyllum* leaf size in Exp.1 excluding the combinations, where most or all plants died (Table 3). Such extreme reaction appeared in media containing RN in both experiments, where growth was poor and plants slowly died, and when plants were grown in rockwool alone in Exp.1 - probably due to the moisture stress shortly after transplanting because plants were very small. In remaining media only fresh weight showed significant reaction: it was biggest in WrR+P and smallest in WrR+P+B+S. Diversity was higher in Exp.2. Plants did not fail to grow completely in rockwool alone, but the growth was also weaker than in other media. The most abundant plants were produced in both kinds of rockwool mixed with peat, bark and sand.

Table 3.

Growth characteristics of *Spatiphyllum floribundum* as influenced by growing media containing rockwool[1)]

Growing medium	Leaf length (cm)[2)]		Leaf width (cm)[3)]		Fresh weight of upper plant part (g)	
	Exp.I	Exp.II	Exp.I	Exp.II	Exp.I	Exp.II
Control (P+Pe :1)	12.6 a[4)]	29.9 bc	6.9 a	9.1 ab	208 ab	189 b
WaR	–	27.9 ab	–	9.4 abc	–	107 a
UR	–	30.1 bc	–	10.9 bcd	–	102 a
WrR+P	12.6 a	23.7 a	7.0 a	8.5 a	233 b	90 a
UR+P	12.5 a	34.4 cd	7.0 a	10.8 bcd	207 ab	199 b
RN+P	–	–	–	–	–	–
WrR+P+B+S	12.3 a	35.8 d	6.8 a	12.1 d	184 a	238 b
UR+P+B+S	11.3 a	31.4 bcd	6.7 a	11.1 bcd	214 ab	209 b
RN+P+B+S	–	–	–	–	–	–
RG+P+B+S	12.2 a	32.2 bc	6.7 a	11.3 cd	203 ab	225.b

Explanations:

1) In treatments without data most or all plants died

2) In Exp.1 the length of all leaves was measured: main plant and side branches. In Exp.2 only main plant was measured

3) Three widest leaves per plant were measured

4) Means with the same letter do not differ significantly according to the Duncan's range test at 5% level

Generally all investigated kinds of rockwool except the granulated rockwool from Nidzica (RN) appeared to be a good ingredient of potting media. Two-component as well as four-component media containing rockwool had good physical properties (M a r t y n and S t r o j n y, 1996). Their total porosity was 70-85%, air capacity at pF2 - 60% and air/water ratio 1/0.6 in average. Rockwool alone had air/water ratio 1/<0.2, which means low water capacity and necessity of careful regulation of plant growth conditions. But each plant responded little different to particular growing media and in practice this specific reaction should be taken into account. Also B r o w n and E m i n o (1981) noticed, that relation of plant with the physical and chemical characteristics of the medium is not always valid and the plant itself remains the final factor evaluating it.

It is also remarkable, that old rockwool, utilised after shredding of used slabs appeared to be as useful or even better as new, granulated rockwool 'Grodan'. It means that big potential source of cheap growing medium for pot plants exists, and besides it allows to utilise the environmentally unfriendly waste material.

It can be also noticed, that regular insulation granulated rockwool as RG can be used, if it does not contain amendments toxic for plants. Such amendments contained another insulation rockwool RN, which made it unsuitable as a plant growth medium.

CONCLUSIONS

1. All investigated kinds of rockwool except the granulated rockwool from Nidzica appeared to be a good ingredient of potting media. Particular plant species expressed somewhat diversified reaction, but generally mixture of rockwool with peat or peat, bark and sand provided good conditions for growing plants. Rockwool alone as a substrate was little worse for *Spathiphyllum* than for *Peperomia* and *Streptocarpus*.
2. The best kind of rockwool appeared to be utilised rockwool.
3. Using utilised rockwool allows to gain cheap source of good potting medium and to bring into cultivation the environmentally unfriendly waste material.

REFERENCES

Anonymous, 1992. Grodan mineral wool, the first name in root zone conditioning. Grodania A/S leaflet.

Brown O. D. R., Emino E. R., 1981. Response of container-grown plants to six consumer growing media. HortScience. 16 (1): 78-80.

Bunt A. C., 1976. Modern potting composts. Pennsylvania State University Press, London

Burghardt H., Ellering K., 1987. Nahrstoffversorgung verschiedener Gesneriaceen. Gartnerborse und Gartenwelt. 87 (32): 1194-1199.

Conover C. A., Poole R. T., 1986. Effect of nitrogen source and potting media on growth of *Chamaedorea elegans, Dieffenbachia maculata* 'Camille' and *Peperomia obtusifolia*. Proc. Florida State Hort. Soc.. 99: 282-284.

Contrisciano T. M., Holcomb E. J., 1995. Growth bedding plants and poinsettias in mineral wool and mineral wool/peat substrates. Communications in Soil Science and Plant Analysis, 26 (3-4): 485-501.

Fischer M., Hentig W. U. von, 1981. Vermehrung von Elatiorbegonien und *Streptocarpus* fur Hydrokulturen. Dt. Gartenbau. 36 (22): 910-912.

Lee C. W., Goldsberry K. L., Hanan J. J., 1987. Evaluation of loose rockwool as a growing medium for poinsettia in comparison with perlite and soil mixes. Res. Bull. Colorado Greenhouse Growers' Assoc. 441: 1-2

Leidenfrost E., Elgner N., 1985. Fünf Fertigsubstrate für Poinsettien gepruft. Dt. Gartenbau.

Martyn W., Strojny Z., 1996. Właściwości wodno-powietrzne mieszanek podłożowych z wykorzystaniem w nich wełny mineralnej. Zesz. Probl. Post. Nauk Rol. 429: 233-240.

Mc Connell D. B., Shiralipour A., 1991. Foliage plant growth in potting mixes formulated with composed yard waste. Proc. Florida State Hort. Soc. 104: 311-313.

Nelson P. V., 1998. Greenhouse operation and management, 5th ed. Prentice Hall, Englewood Cliffs, NJ

Poole R. T., Conover C. A., 1986. Growth and tissue content of foliage plants grown in various media with different micronutrient levels. Proc. Interamerican Soc.Tropical Hort., 30: 147-157

Przydatność wełny mineralnej jako podłoża dla *Peperomia obtusifolia*, *Streptocarpus hybridus* oraz *Spathiphyllum floribundum*

Streszczenie

W dwóch doświadczeniach badano przydatność granulowanej wełny mineralnej 'Grodan', utylizowanej, poprodukcyjnej wełny w postaci płyt – po jej rozdrobnieniu, oraz granulowanej wełny budowlanej rodzimej produkcji z Gliwic i z Nidzicy, jako podłoża lub składnika podłoży w mieszankach z torfem, korą i piaskiem do uprawy wymienionych w tytule gatunków roślin ozdobnych. Reakcja poszczególnych roślin wykazała pewne zróżnicowanie, ale generalnie wełna wykazała pełną przydatność jako podłoże lub jego składnik. Najbardziej korzystne działanie wykazała wełna utylizowana. Wełna budowlana z Gliwic okazała się przydatna w mieszance, gdzie stanowiła 25% objętości podłoża, natomiast z Nidzicy – nieprzydatna do uprawy z uwagi na zawartość dodatków wpływających toksycznie na rośliny.