The Use of Paper Pots in Plant Production

Hendrik Averdieck
Versuchs- und Beratungsring Baumschulen, Postfach 12 29, 25402 Pinneberg, Germany

INTRODUCTION

The nursery stock industry has some 35 years of practical experience of growing woody plants in plastic pots. Research to develop alternative pots, made of biodegradable material, started approximately 15 years ago in response to: the increasing problem of waste disposal in industrialised countries; a growing ecological awareness; a rise in prices for plastic; and the possible technical advantages such pots might have for growers. From the many materials examined (paper, plant fibres from flax or coconut, wood fibres mixed with peat, laminated wood, biodegradable plastic), only a few satisfy the necessary requirements: sufficient durability; ability to be used in potting machines; and rotting ability after planting. This last point is particularly important for large volume pots. Two trials were undertaken to test the performance of 10-litre pots made of waste paper.

MATERIALS AND METHODS

Comparison of Container Material.

Trial 1: Comparison of Containers. Trial species were *Malus domestica* 'Cox Orange Pippin' and *Salix caprea* 'Weeping Sally' (syn. 'Pendula'). They were potted into four different 10-litre containers: Kitty-plast bio container "grey" (durability 2 to 4 years), Kitty-plast bio container "red" (durability 8 to 12 months), KEF pot, and plastic container (PP). The substrate consisted of peat, bark humus, wood fibre, clay, and green compost (48 : 30 : 10 : 7 : 5, by volume), fertilised with the controlled-release fertiliser Plantacote Depot 8M at 4 kg m^{-3}, and irrigated by drip irrigation. At the end of the trial growth parameters such as plant height, stem diameter, and shoot size were recorded. Subsequently the trial plants were planted into the field. Plastic pots were removed but degradable pots were left in position. Speed of establishment and quality of subsequent growth were measured.

Trial 2: Comparison of Substrate and Irrigation Method. Trial species were *Betula pendula* 'Youngii' and *S. cinerea*. They were potted into two types of 10-litre container: plastic container (PP) and KEF-pot. Four different substrates were compared: peat (100%); peat, wood fibre, bio compost, clay, and gravel (50 : 30 : 10 : 5 : 5, by volume); peat, wood fibre, and gravel (40 : 55: 5, by volume); and wood fibre and coconut pith (4 : 1, v/v). All substrates were fertilised with the controlled-release fertiliser, Osmocote Plus 8-9M, at 4 kg m^{-3}. Two different irrigation procedures were also compared for each combination of pot type and substrate: drip irrigation and capillary mat.

RESULTS

Comparison of Container Material. The container material had no influence on the plant height nor the stem diameter of *M. domestica* 'Cox Orange Pippin' (Table 1). With *S. caprea* 'Weeping Sally', pot material appeared to have a small influence on the number of long pendulous branches and on stem diameter (Table 2).

Table 1. Effect of pot type on growth of *Malus domestica* 'Cox Orange Pippin'.

Type of pot	Plant height (cm)	Stem diameter (mm)
Kitty-plast "grey"	188.48	17.4
Kitty-plast "red"	188.63	17.6
KEF pot	185.56	18.5
Plastic pot	183.32	18.5

Table 2. Effect of pot type on growth of *Salix caprea* 'Weeping Sally'.

Type of pot	Pendulous branches (no. of long)	Stem diameter (mm)
Kitty-plast "grey"	7.5	18.9
Kitty-plast "red"	11	20.0
KEF pot	8	19.2
Plastic pot	10	19.2

Root growth was more strongly influenced than shoot growth by pot type, with root circling appearing on plants grown in plastic pots but not in paper pots. The roots grew through the pot wall of Kitty-plast bio containers. When the roots emerged they were air-pruned which promoted growth of a better, more fibrous root system within the pot. With KEF pots roots were unable to grow through the side wall but did grow through the bottom of the pots. After planting out, plants in Kitty-plast bio containers showed comparable growth to those planted without pots in the first year because the roots were able to penetrate the pot wall. In contrast the pot wall of the KEF pot remained impenetrable and plant growth was reduced because of lack of water and nutrients (Table 3).

Table 3. Comparison of pot type on growth of *Salix caprea* "Weeping Sally' after planting out.

Type of pot	Pendulous branches (no. of long)	Stem diameter (mm)
Kitty plast "grey"*	30	24.0
Kitty plast "red"*	25	24.0
KEF pot*	16	20.0
Plastic pot**	29	25.0

*Planted with pot
**Pot removed before planting

Comparison of Substrate and Irrigation Method. The differences between the different substrates and the two-pot types were quite small when drip irrigation was used. *Betula pendula* 'Youngii' grew more strongly in substrates containing wood fibre than in peat (Table 4).

Table 4. Effect of substrate and pot type on stem diameter (mm) of *Betula pendula* 'Youngii' (drip-irrigation).

Type of substrate	Plastic pot	KEF pot
Peat 100%	12.6	12.9
Peat, wood fibre, bio compost, clay, and gravel (55 : 30 : 10 : 5 : 5, by volume)	13.7	13.4
Wood fibre, peat, and gravel (55 : 40 : 5, by volume)	14.5	13.9
Wood fibre and coconut pith (4 : 1, v/v)	13.9	14.1

Clear growth differences between the potting substrates occurred with *S. cinerea* grown on capillary mat. The strongest plants were produced in pure peat and reducing the proportion of peat in the substrate resulted in poorer growth. Here the differences between both container types were small. Plants grown in paper pots produced a slightly increased shoot fresh weight but the results for compost comparison were independent of the type of container (Table 5).

Table 5. Effect of substrate and pot type on shoot fresh weight (g) of *Salix cinerea* (capillary mat).

Type of substrate	Plastic pot	KEF pot
Peat 100%	563.1	600.3
Peat, wood fibre, bio compost, clay, and gravel (55 : 30 : 10 : 5 : 5, by volume)	420.0	475.0
Wood fibre, peat, and gravel (55 : 40 : 5, by volume)	550.6	487.9
Wood fibre and coconut pith (4 : 1, v/v)	350.0	406.9

The cause of the differences in growth between the different substrates was the amount of nutrient or salinity in the containers, and the effects were enhanced in nonpeat media and on capillary mat (Table 6 shows the example of potassium).

Table 6. Amount of potassium (mg litre^{-1}) in the different substrates at the beginning and end of the trial (capillary mat).

Type of substrate	Initial amount in substrate	Final amount (plastic pot)	Final amount (KEF pot)
Peat 100%	17	19	17
Peat, wood fibre, bio compost, clay and gravel (50 : 30 : 10 : 5 : 5, by volume)	166	128	104
Wood fibre, peat, and gravel (55 : 40 : 5, by volume)	47	69	39
Wood fibre and coconut pith (4 : 1, v/v)	315	137	224

There were clear differences in water consumption between the plastic pot and the paper pots. On capillary mat, four times as much water was used by the crop in paper pots as the crop in plastic pots, as regulated by tensiometers.

CONCLUSION

It is possible to produce nursery stock in 10-litre degradable paper pots to an equivalent quality and using the same growing regimes as for production in plastic pots. Peat-reduced substrates can be used. The use of capillary mat irrigation is possible, if good, low-salt substrates are used. A particular advantage of paper pots is that no root circling occurs and a compact, fibrous, self-pruned rootball is able to develop. The KEF pot is a durable container with an acceptable appearance but it does not degrade quickly enough when planted. The Kitty-plast bio containers allow a good rooting through after planting in the soil, but durability during cultivation and shipping is not as good as the KEF pot. In the current market it is not possible to pass the higher cost of the pot and higher production costs on to the customer.