EFFICIENCY OF CAPILLARY MATTINGS BY GROWING POTPLANTS*

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Abstract

Use of capillary mattings by growing potplants

By growing potplants the Dutch growers often use capillary mattings. How are the differences between the several mattings which are on the market?

INTRODUCTION

In the potplant industry watering is an often repeated operation. Since this is a rather labour-intensive activity, and watering "by hand" is often not very even and, besides, does not always ocour at the appropriate time, research has been made to find better methods.

One of these methods is to place the potplants on capillary mattings, so that the plants can take the necessary water from the wet matting.

In order to gain a better knowledge of the properties of the large number of mattings on the market, these materials have been tested.

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CAPILLARY MATTINGS

There is a wide variety of composition and structure in the fifteen mattings included in this testing procedure.
Raw materials used are wool, cotton, rayon, synthetic fibres and rockwool. Great differences in thickness and tension could also be established. A good capillary matting should meet the following requirements:

- The material should be synthetic for 100%. This is desirable for two reasons:
  a. Biological decomposition needs, especially in the beginning, nitrogen. The nitrogen is withdrawn from the nutrient solution in the water. Consequently, the plants could suffer a shortage of nitrogen.
  b. The duration of use of synthetics is much longer than that of natural raw materials.
- A large water storage capacity. A large buffer ability enables the watering frequency to be reduced. As a result, differences are levelled off and labour can be saved.
- An adequate horizontal and vertical water transport through the matting, so that all the pots receive an equal quantity of water. The vertical absorption is also essential for levelling the stagings. Should the mattings lie strictly horizontal or is a slight decline still possible?
- The mattings should be shrinkproof, so that the area available for cultivation remains unchanged.
- The pH and the salt concentration in the water may only slightly be affected by the mattings.
- No root penetration, so that the plants can easily be removed without breaking the roots or damaging the matting.

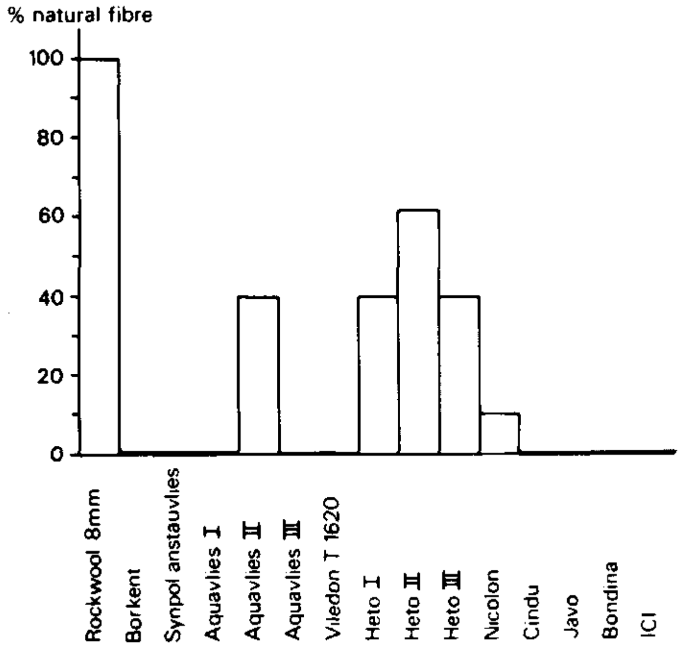

Fig. 1 Rate of natural fibre used in capillary mattings

Experimental set-up

The basis was a window pane measuring 50 x 50 cm, in which a pattern was scratched, consisting of five squares concentrically placed round the centre. The smallest square with sides of 5 x 5 cm was surrounded by four different squares, the sides of each following square being 5 cm longer.
A sample of the matting to be tested (50 x 50 cm) was put on the window pane, and on the matting a frame of polyvinyl chloride tube and copper wire was placed, which had the same dimensions as the pattern in the pane. The polyvinyl chloride tube was cross-shaped and rested on the matting by means of a number of small nails. As a consequence, the effect of the frame on the water-bearing capacity of the matting could practically be neglected.
In order to enable the observation of the bottom surface of the matting, a mirror has been fitted at about 10 cm below the window pane. The water used was coloured for the sake of an easy observation and, through a small funnel (Ø 3 mm), was supplied to the centre of the matting. The water flow was adjusted to such an extent that just no puddle appeared on the matting surface.

The entire experimental set-up was placed on a set of scales, so that the quantity of water added could be observed at any stage of the experiment.
At the start of the test the weight of the dry matting was measured, and then the weight was taken down every five minutes in order to check an even supply. For an indication of the horizontal movement through the matting, the moment was noted down when the water line passed the sides of the squares above and below the matting.
The water supply was stopped when the first drop fell from the pane. At the moment the final weight was observed, from which datum the water storage capacity of the matting was calculated.
Since it could be expected that the water storage capacity of new mattings would differ from that of used ones, the experiment was first carried out with a new matting, which was dried at a temperature of 70°C for 48 hours, and then tested again.

Test procedure

Moistening

Moistening of the mattings was done from a central point. Previously the weight of the matting was determined. During the experiment the weight was determined every five minutes. The adjustment of the water supply just prevented a puddle from appearing on the matting surface. The water supply was cut off at the very moment when the water would start dripping from the matting, at the same time the total weight was determined so that the water storage capacity of the matting could be calculated.

Results

The values found are given in Figs. 2 and 3. The test was carried out several times, and it became evident that the composition of various mattings was not the same.
The values stated are average values.
Likewise it could be established that used mattings have a smaller water storage capacity than new ones.
It was found, too, that in fully synthetic mattings the distribution of water was considerably better than in mattings with cotton, woollen or such constitions.

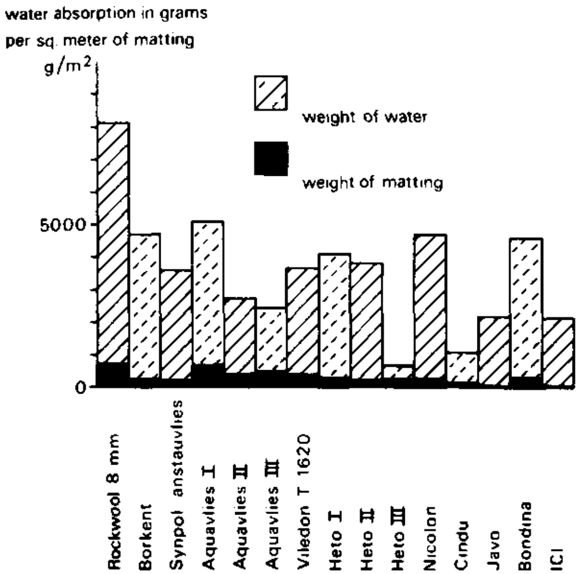

Fig. 2 Water storage capacity in new mattings when moistened centrally.

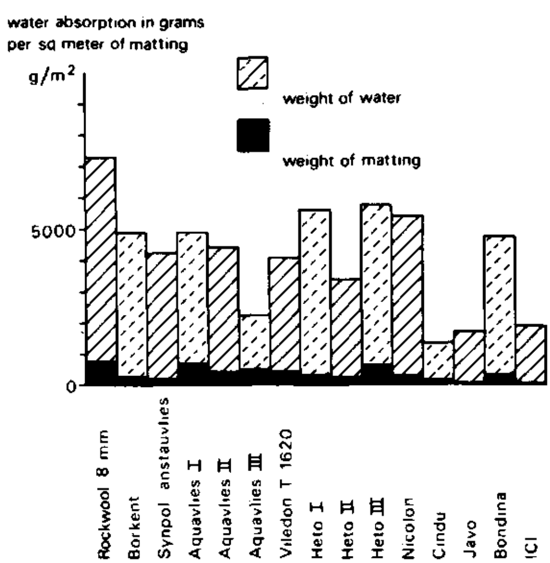

Fig. 3 Water storage capacity in used mattings when moistened centrally.

Absorption speed

The absorption time for 10 ml of water in a matting was determined. It was measured how many seconds it took before the first marks of the liquid became visible under the matting, and how many seconds it took before the quantity of 10 ml was completely absorbed by the matting. The same was done with used mattings.

Results

The Figs. 4 and 5 show the average results. Considerable differences between one matting and another became evident, but also between new mattings and used ones. There were also considerable differences when the test was repeated, which once more emphasizes the heterogeneity of several mattings.

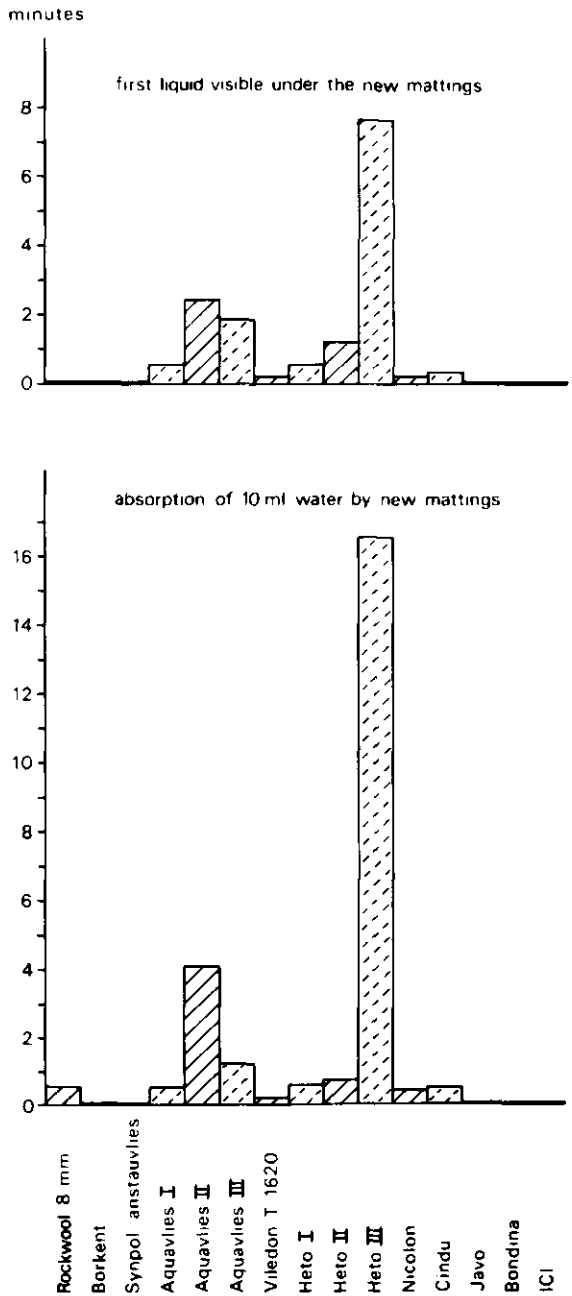

Fig. 4 Rate of absorption in new mattings.

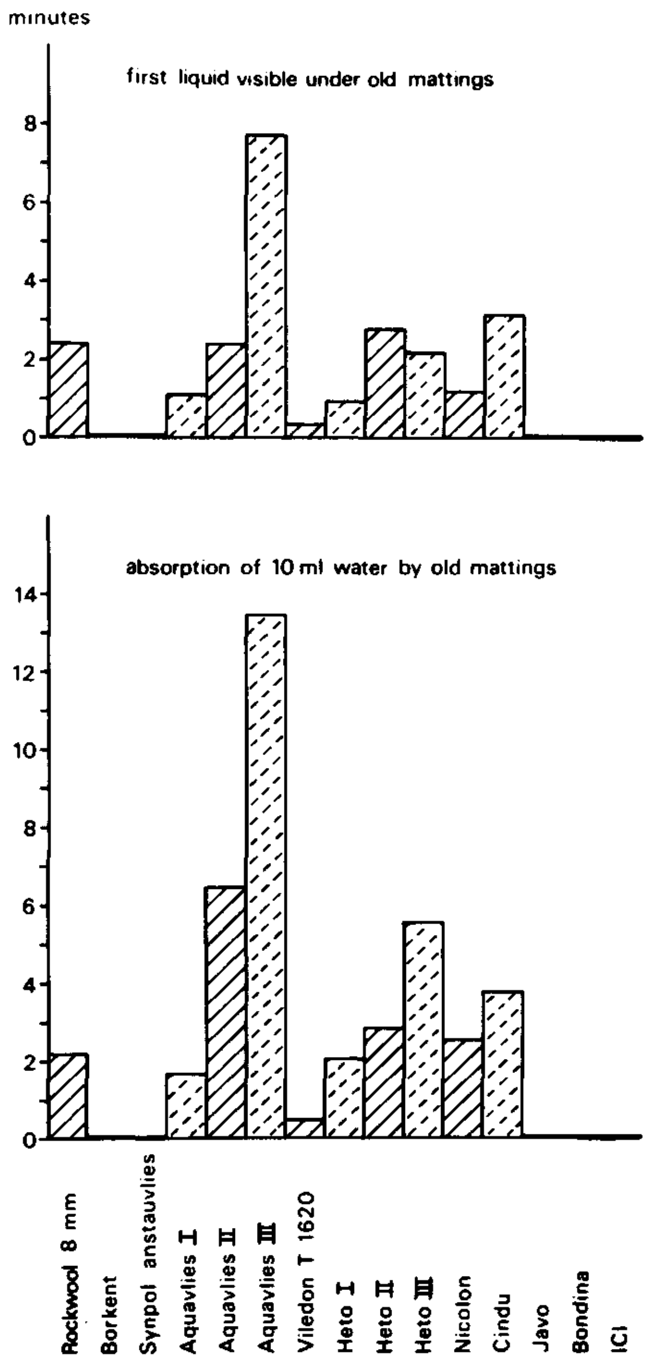

Fig. 5 Rate of absorption in used mattings.

Shrinkage

In order to determine the shrink-resistance, mattings fully saturated with water were dried at 70°C for 48 hours. Before wetting and immediately after drying the dimensions were measured. From the figures obtained the percentage decrease in the surface was calculated.

Results

It was found (Fig. 6) that only a few mattings show a shrinkage of 1% or less. One of the requirements to be made on a good capillary matting is a maximum allowance for shrinkage of 1%.

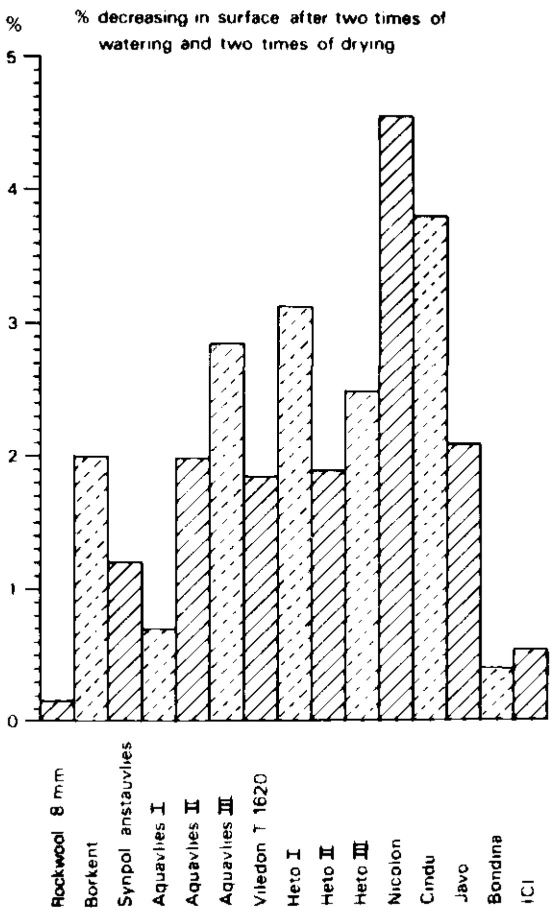

Fig. 6 Shrinkage of capillary mattings

Capillary attraction

The capillary attraction capacities of the mattings have been tested in view of the demands to be made on the levelling of the stagings.
Matting strips of a length of 30 cm and a width of 5 cm were suspended by 1 cm into water; after 1, 24 and 72 hours respectively the capillary rise of water was measured.
Both new and used mattings were tested in this way.

Results

Generally speaking, the capillary rise in used mattings is slightly higher than in new ones. It is remarkable that most mattings have a capillary action of only 2 or 3 cm.
The difference between the capillary levels after 24 and 72 hours appeared to be negligible. Consequently, high demands are to be made on the levelling of the stagings.
The corresponding Figures are given in Fig. 7.

Cindu A: measurement cross on the length

Cindu B: lengthwise measurement

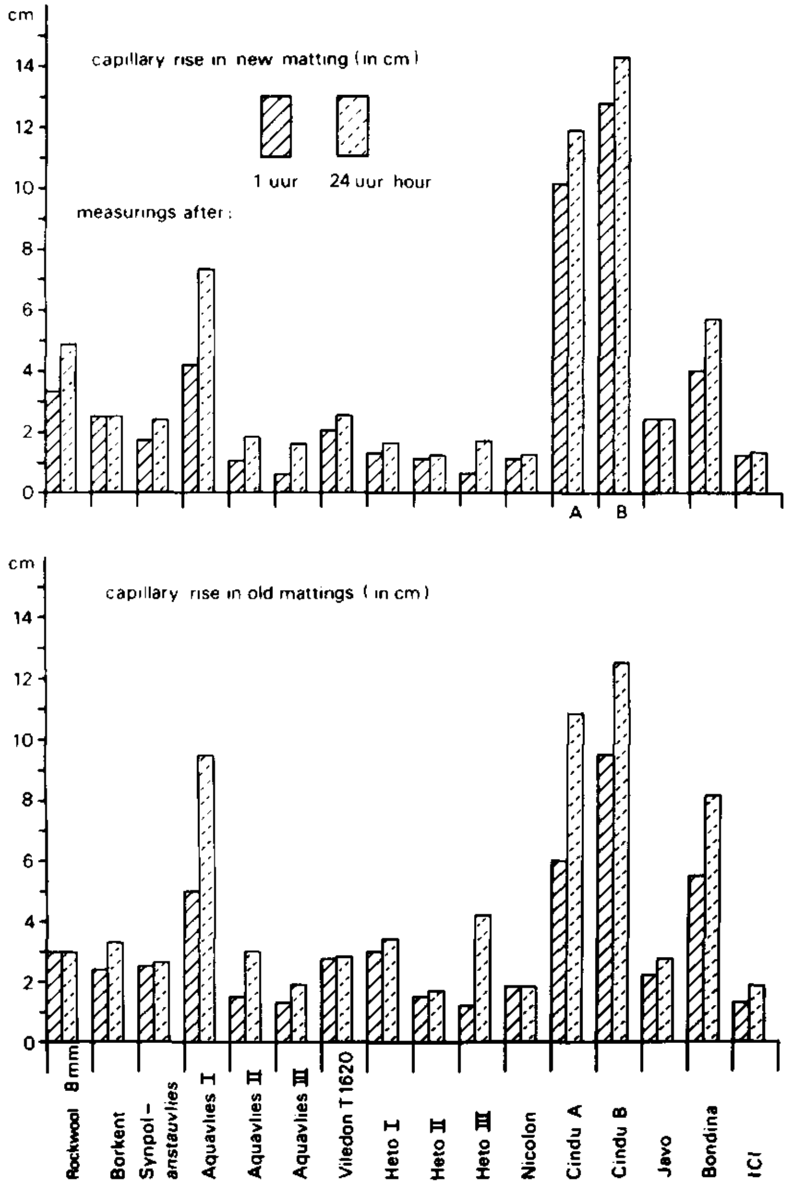

Fig.7 Capillary rise in new and used mattings (in cm)

Tests on pH and salinity (EC)

In order to detect any effect of the mattings on the pH and salinity of the irrigation water, tests were carried out for this reason.
To this end the mattings were immersed in distilled water, and the pH and the salinity (EC) were determined after 1, 4 and 24 hours respectively.

Results

All the mattings appeared to have a pH increasing influence ranging from 0.15 to 2.1.
For the two mattings with the greatest pH increases (rockwool and Bondina) the pH measurements were repeated after 48 hours, and it appeared that the pH increasing action was still continuing, viz. 2.53 and 1.96 respectively.
The tabel below shows the basic pH values for the various mattings.

Rockwool	4.72	Heto I	5.30
Borkent	5.48	Heto II	5.15
Synpol-Anstauvlies	5.38	Heto III	5.20
Aquavlies I	5.20	Nicolon	5.28
Aquavlies II	5.39	Cindu	5.21
Aquavlies III	5.20	Javo	5.49
Viledon	5.22	Bondina	5.14
		ICI	5.43

The salinity tests allow the conclusion that the influence of the salt concentration on the irrigation water is only small.
The corresponding values are stated in Figs. 8 and 9.

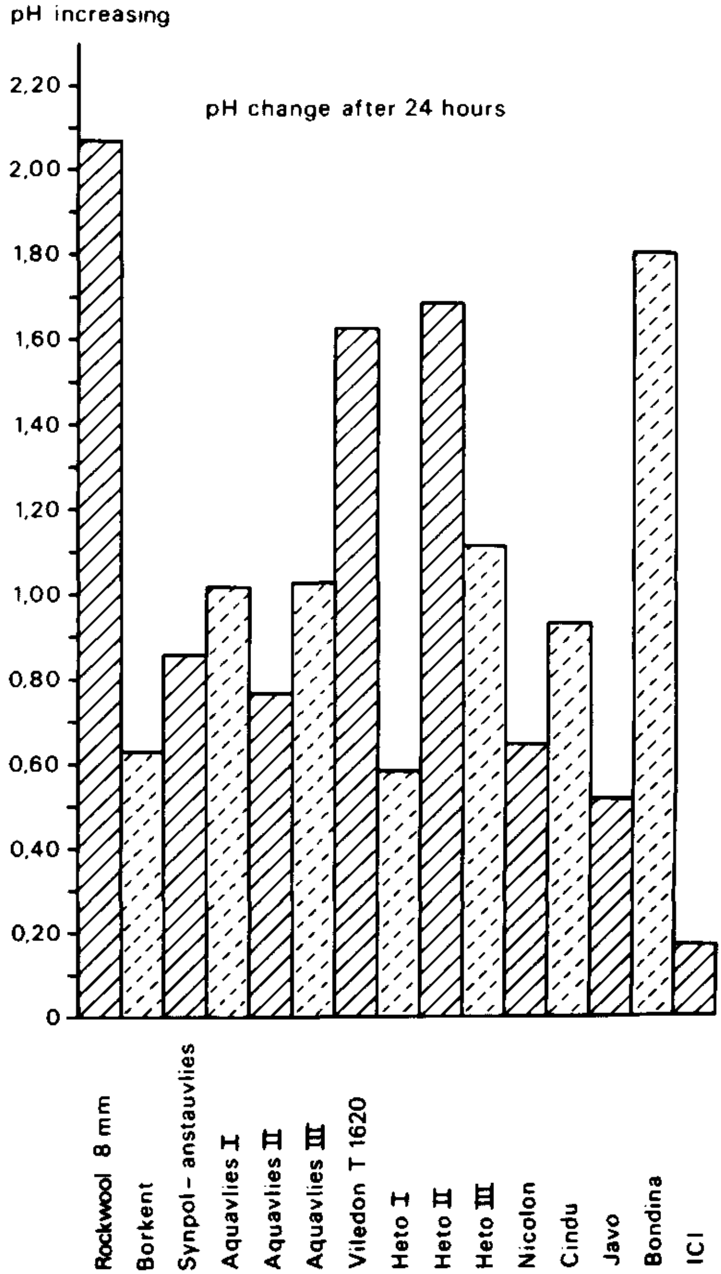

Fig. 8 Change of pH level after 24 hours

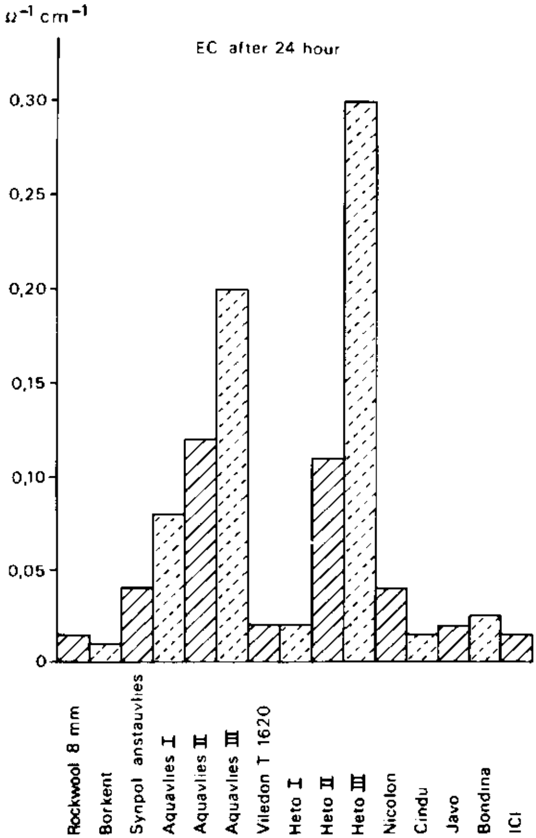

Fig. 9 Influence by new mattings on the salt concentration

Tensile strength

The object of these tests was to get an impression about the movability of mattings used in practice. The measurements were carried out lengthwise with strips as stated in Fig. 10.
The drawing speed was 15 cm/min. A recorder was attached to the meter.

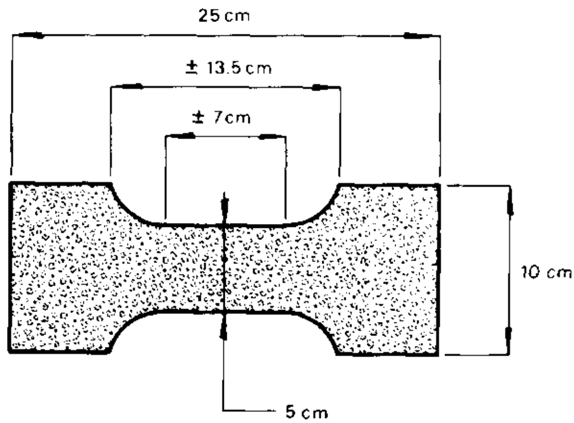

Fig. 10 Dimensions and form of the watering mat for the strength tests.

Results

With this aspect, too, there appeared to be quite a heterogeneity, since the values found in repetition often differed considerably. The figures in Fig. 11 are the average values found. It may be concluded from these results that most mattings are not very strong.

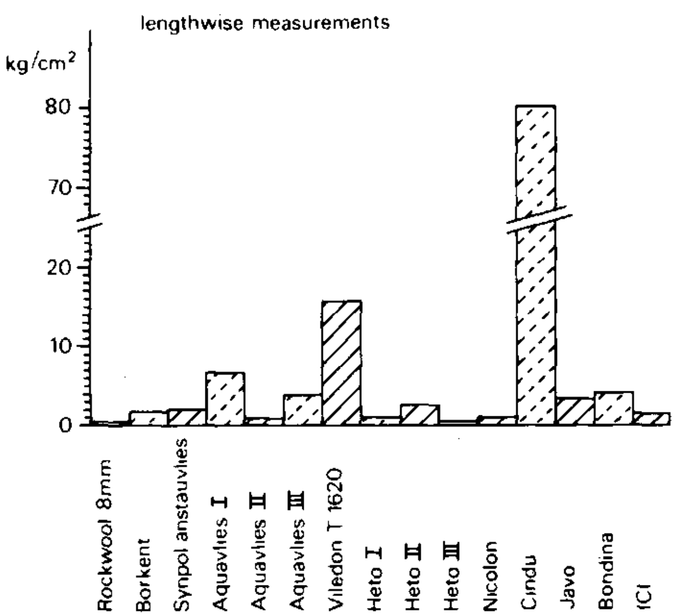

Fig. 11 Maximum pull in dry mattings (in kg/cm^2)

Root penetration

It is important that potplants grown on capillary mattings should not penetrate into these mattings.
For that reason the root penetration into the mattings under consideration was examined. The various mattings were laid on stagings; there was a foil under the mattings.
On each plot of 2.45 x 1.50 a number of 45 pot chrysanthemums in 9 cm plastic pots were placed.
In a view of the difference in the rate of evaporation, the water supply was carried out "by hand".
Every four weeks the degree of root penetration into or through the mattings was examined.
The Cindu matting was used in combination with a layer of 2 cm of sand. The matting came up to the expectations fairly well. In earlier examinations it was found that the inner layer of this matting, which consists of three layers, can be penetrated by roots, but not the outer layers. This outer layer can be used very well in combination with a sand bed. The matting can then be very thin (25 g/m^2).

Examination table

	absorption speed[1]	water storage capacity[2]	distribution of water	capillary attraction[3]	tensile strength per cm^2 of wet mattings[4]	shrinkage[5]	usefulness in view of root penetration	percentage of synthetics
Rockwool	0	++	0	0	--	++	-	0
Borkent	++	+	+	0	0	-	-	100
Synpol-Anstauvlies	++	+	++	0	-	0	-	100
Aquavlies I	0	+	0	++	+	+	-	100
Aquavlies II	-	+	-	+	-	-	-	60
Aquavlies III	--	+	--	0	0	--	-	100
Viledon T1620	+	+	+	0	+	-	-	100
Heto I	0	++	--	0	-	--	-	60
Heto II	0	+	-	-	-	-	-	45
Heto III	--	++	--	0	--	-	-	60
Nicolon	0	++	--	-	-	--	-	90
Cindu	0	-	-	++	+	--	+	100
Javo	++	-	+	-	-	-	-	100
Bondina	++	+	++	+	+	+	-	100
ICI	++	-	0	-	-	+	-	100

Standards[1] 1-2 min = 0 [2] 4 l/m^2 = - [3] 3-4 cm = 0 [4] 5 kg/cm^2 = - [5] 1% = +

Relative table

++ = very good

\+ = good

0 = moderate

\- = poor

-- = very poor

CONCLUSION

In the table of page 17 the results of all the tests are summarized. From the examination Bondina is the matting which appears to be the best. This matting comes up well or very well to the several requirements made.
Aquavlies I and Synpol-Anstauvlies stand second. The advantage of Aquavlies I is its good capillary attraction, while Synpol-Anstauvlies distinguishes itself by a high rate of absorption and a very good distribution of water. A disadvantage, however, is the root penetration into the mattings, which will cause difficulties when using the mattings in commercial potplant growing.
The next mattings are Borkent en Viledon T1620, which come off fairly well, too; a considerable shrinkage of these mattings should be taken into account.
All the other mattings show so many undesirable properties that they fail to meet the requirements made.
Furthermore, it has to be remarked that only Cindu can prevent the roots from penetrating the matting. This mat can be used very well for covering a sand bed.
Since it is in fact the outer layer that prevents root penetration, this layer will suffice.

LITERATURE

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