Peat substitutes in growing cucumber transplants

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Summary: The use of an adequate medium is very much emphasised in growing transplants. Due to their favourable characteristics, peats have long been used in production. With the depletion of peat resources the research of peat substitutes has come in the foreground. In the experiments cucumber transplants were grown using baked, expanded clay granules. Results have indicated that by mixing them to peat in a 50 % rate they could be suitable mineral material as a component for soil mixtures.

Key words: peat substitutes, transplant growing, baked, expanded clay granules

Introduction

Nowadays, for open field vegetable production transplants are produced with bare root or as plugs. Earliness and yield security are guaranteed by the plug transplant technology, in which case transplant roots develop in a separate medium and the transplant is planted out together with the medium, ensuring a better establishment. Methods of plug growing include the use of soil blocks, grass blocks, pots and seedling trays.

Recently, the use of seedling trays has been becoming a more and more common transplant growing method. It is mainly recommended to mass production purposes that transplants are intended for when produced in the trays and plant roots develop in a small medium. Therefore it is very important to use adequate soil mixtures. Studying the circle of the materials available, in the experiments expanded clay granules were used for vegetable transplant growing.

Media of high organic matter content, such as peats, have long been used as suitable natural substances for transplant production. They have good structural characteristics by nature, containing some plant nutrients as well, and are considered aseptic (*Terbe*, 2001).

In horticultural production, under intensive growing conditions, the use of peat base soil mixtures is very common. Their use is justified not only by the utilisation of potential nitrogen sources, but also by the multifunctional nature of the humus materials, such as adsorption and buffer capacity. Peat as a natural substance is available in limited quantities; therefore exploring for peat substitutes is an important task (*Forró*, 1997).

Parallel to organic materials (composts, tree bark, coir etc.) (*Flegmann & Raymond, 1977*) experiments have been going on involving the mineral media (rockwool, perlite, ceramic gravel) (*Baudoin et.al., 1990*) that could potentially substitute peat. Using these materials as growing media, a number of researchers have reported on positive results *(Hall & McGregor*, 1984; *Wendt*, 1991; *Riverio&Fuentes*, 1988; *Sári* et al., 2002). The testing of baked clay granules in vegetable production was carried out in recent years (*Imre, 1994*).

Material and method

Soil mixtures for transplant growing were produced by mixing up different ratios of low moor peat, high moor peat, clay granules and perlite (Table 1). The clay granules utilised had a 1-4 mm grain size and were tested in whole and smashed form. According to the manufacturer, the difference between the two substances is that the sharp-grained (smashed) material has a better water adsorption and storing capacity. The capillary rise capacity of the media was checked also in our laboratory. The control was an even mixture of the two types of peat.

Cucumber was used as test plant, as its transplant raising takes a very short time and the nutrient contents of the sowing media have no influence on germination.

Experiments were set up in high plastic tunnels equipped with heating at the Experimental Farm of the Budapest University of Economic Sciences and Public Administration at Soroksár.

Parameters of the growing technology:

Test plant: cucumber (variety: Dózer)
Tray type: Hungarocell KITE tray with 187 cells
Method of filling: by hand, loose filling
Sowing date: 02.04.2003
Harvest date: 14.04.2003

Materials utilised: low moor peat from Pötréte
high moor bog peat of Baltic origin
horticultural perlite
expanded clay granules 1 (whole)
expanded clay granules 2 (smashed)

Nutrient replenishment: 2 kg/m^3 PEAT-MIX
2 kg/m^3 Superphosphate

Irrigation was applied in accordance with plant requirements in the morning and evening hours.

Pesticide treatments were applied: after sowing for the control of damping-off and on two occasions for insect control.

The investigation was carried out in 6 repetitions.

Tests and measurements

In the experiment, the following parameters were studied:

Germination: after the emergence of the first seedlings the number of newly emerged seedlings per plot was counted every day. Counting was going on until the number of plants remained unchanged for several days.

Stem diameter: it was measured 1 cm from the neck of the root using a digital calliper, with 0.01 cm precision. 10 plants were measured and the plot was characterised by their average.

Plant height: it was measured from the soil surface to the growing point using a ruler, with 0.1 cm precision. 10 plants were measured in each plot and the plot was characterised by their average.

Fresh weight (foliage weight) of single transplanst: in each plot 10 plants were measured together for the weight of the parts above the soil with 0.1 gr precision and this value was then related to the single transplant.

Dry matter content of green parts: samples taken for fresh weight determination were dried to constant weight after measuring their fresh weight, and the value was calculated from the ratio of the weight remeasured when dry and the fresh weight (%).

Fresh weight of single root: 5 plants were taken from each plot and had their roots washed to remove the soil mixture, than roots were weighed together and the value obtained was then related to the single transplant. It was impossible to raise normal size and marketable transplants on the trays containing purely clay granules, therefore their data are missing from the graph.

Dry matter content of root: samples taken for fresh root weight determination were dried to constant weight after having measured their fresh weight, and the value was calculated from the ratio of the weight remeasured when dry and the fresh weight (%).

Results and discussion

Capillary rise:

Capillary rise of soils means the mm height of rise, as a result of which air dry soil filtered through a 2 mm sieve draws up water in a certain time placed in a minimally 20 mm diameter glass tube with constant water supply. In the experiments capillary rises were determined every hour for the first 5 hours, then at the 24th and 48th hour, as listed in *Table 1*. Capillary rise values may have an importance in horticultural production when sub-irrigation is practised, making this parameter worth to be studied.

Table 1 Compositions of the seedling growing media utilised

Treat-ment	High moor peat %	Low moor peat %	Perlite %	Clay Gr 1 %	Clay Gr 2 %	Futor kg/m^3
0	50	50	0	0	0	1.5
1	25	25	50	0	0	0.75
2	0	0	0	100	0	0
3	25	25	0	50	0	0.75
4	0	0	0	0	100	0
5	25	25	0	0	50	0.75

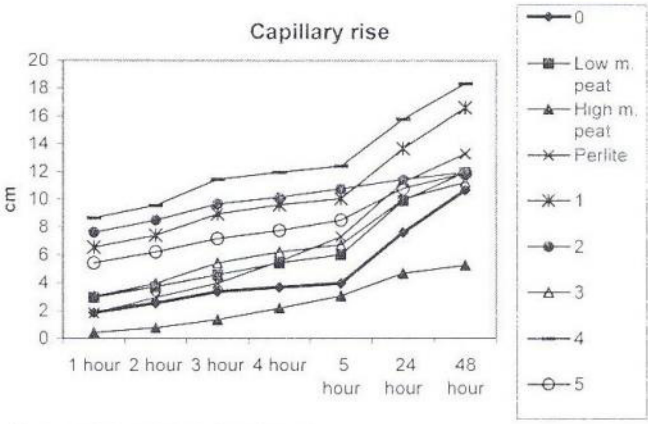

Fig 1 Capillary rise of the mixtures

It was the smashed clay granules that had the best water rise, rising water in 48 hours to a height of over 18 cm. Until the 5th hour rise, also the whole clay granules showed a favourable picture. It is worthwhile to have the results compared to those of perlite, which showed a poor initial water rise, but surpassed whole clay granules at the 24th and 48th hour. Clay granules in each case when mixed with peat improved the water rise potential of the mixture.

Cucumber germination in the control mixture was protracted, mixtures of the two clay granules and peat, however, showed better results as compared to the control, with germination almost as high as 100 % by the 7th day *(Fig 2)*.

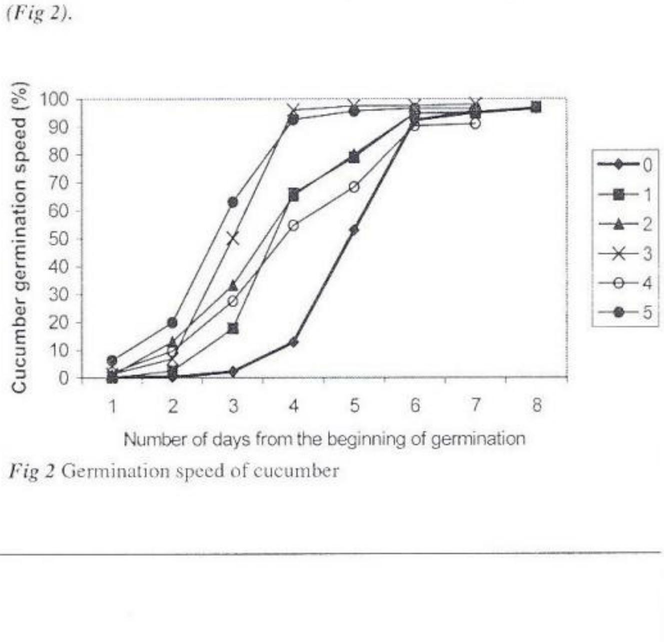

Fig 2 Germination speed of cucumber

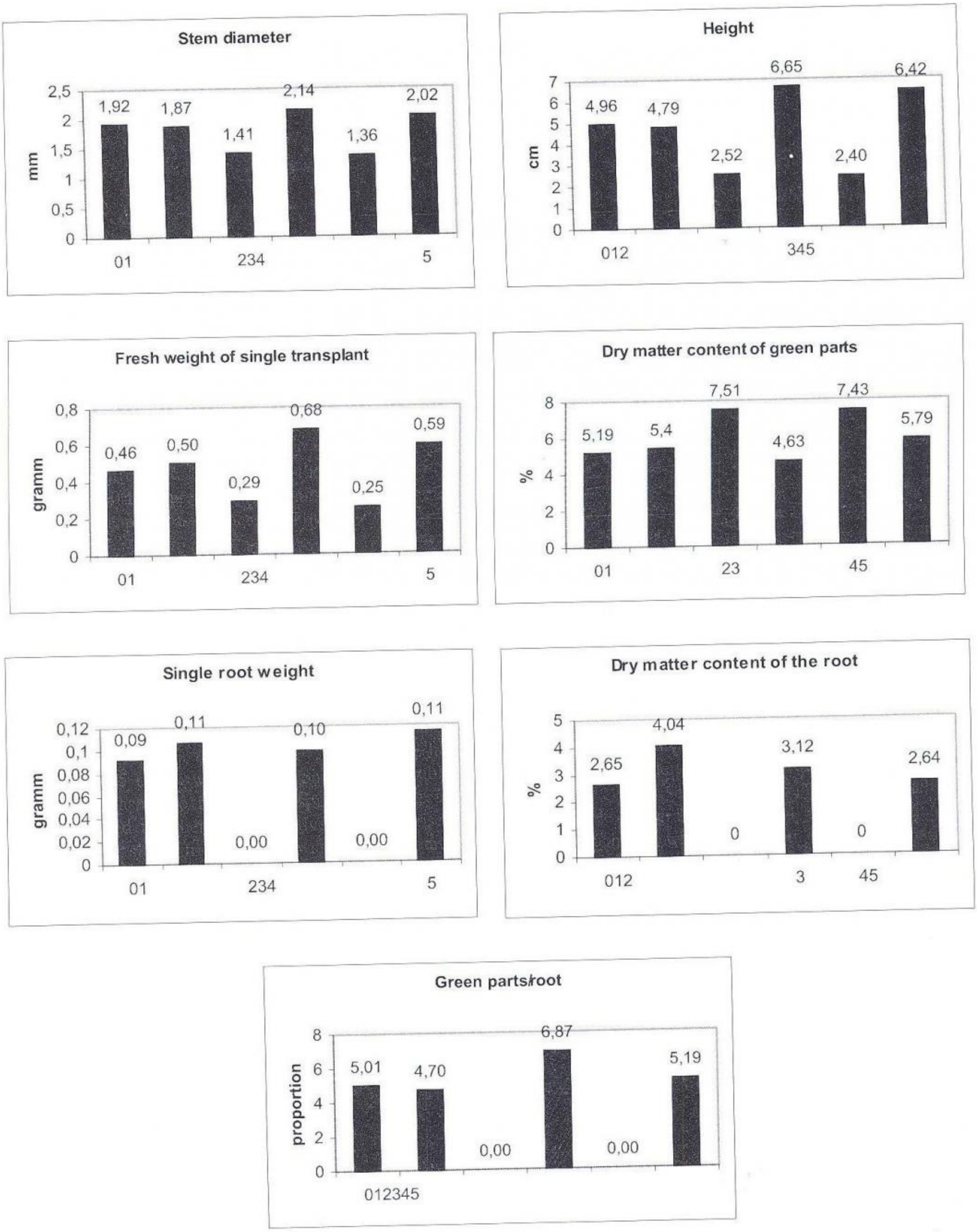

Fig 3 Growth of transplants on different media

Table 2 Influence of the treatments on the development of cucumber transplants

Treatment	Stem diameter (mm)	Height (cm)	Fresh weight of single transplant (g)	Dry matter content of green parts (%)	Single root weight (g)	Dry matter content of the root (%)	Green parts/root proportion
1	1.87	4.79	0.49	5.79	0.53	4.03	4.99
2	1.41	2.52	0.29	7.43	–	–	–
3	2.14	6.64	0.68	4.63	0.49	3.11	7.39
4	1.36	2.39	0.25	7.51	–	–	–
5	2.02	6.41	0.59	5.39	0.57	2.64	5.9
0	1.92	4.96	0.46	5.18	0.46	2.65	5.1
SD99%	0.24	1.18	0.12	0.79	–	–	–
SD95%	0.18	0.87	0.08	0.58	–	1.21	–
SD90%	0.15	0.73	0.07	0.49	–	0.99	1.74

Transplant results: it was impossible to raise normal size cucumber transplants on pure clay granules. This fact is also indicated by the figures from the statistical analysis, where at a 99% significance level different transplants were given in treatment 2 and 4 *(Table 2)*. It can also be seen that transplant size on mixtures of clay granules and peat was statistically larger as compared to the control and the mixture with perlite. Levels of transplant root development did not show any statistical difference *(Fig 3)*.

Conclusions

Clay granules both in whole and smashed form were tested in transplant growing on trays. As it is apparent from the results, transplant development was abnormal on trays containing purely clay granules and not only germination but also plant development were poor on these trays.

Also, some mixtures were prepared that contained 50 % clay granules and in 50 % low moor peat + high moor peat. A perilte + peat mixture was tested as well, with the objective to compare. Cucumber transplant development on the mixture of clay granules and peat was superior both to that on the control and the perlite mixture. Cucumber transplant raising is a short culture and only 12 days passed between sowing and transplanting. For a short time like this, the nutrient supply capacity of the mixtures did not play such an important role as with other plants where plants continue to develop in the trays for much longer periods.

In summary, it can be concluded that clay granule in itself is unsuitable for growing transplants on trays. When mixed with peat, results were superior to those of the control treatment. Therefore, it can be suitable for a 50 % substitution of peat, on the other hand, at the moment the high price prevents it from becoming widely used, besides recycling seeming hardly feasible in this case.

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