Pedological and agrochemical investigations on media using in vegetable forcing

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Summary: In spite of the several good properties of peat, recently, some experiments were carried out with the aim of finding natural materials which can substitute for peat. According to the results, several inorganic and organic materials were proved to be suitable for this purpose. This study examines the effect of different organic materials (example: pine bark, composts, peats) on the growth and yield of green pepper (*Capsicum annuum* L., *variety Danubia*). We found that the most developed plants were grown in peat-mixtures and pine bark. The average fruit weight was the highest at those plants which were planted also in these media. The plants which were grown in composts fell short of our expectations in developement and in yield, too.

Key words: peat-based, substitution for peat, compost, humus quality

Introduction

Growers have already used industrial soil mixtures since several decades. As a result of their presence the output of intensive industries (ornamentals and vegetables) have grown largely. At first, these mixtures were produced from uniform raw materials, with uniform manifacturing process and they were available first in constant quality. The production of industrial soil mixtures was based on peat-reserves, because peat was their main constituent.

High moor peats have more advantageous properties, their structure is fibrous and they have appropriate water-holding capacity. Their salt-content and pH are low, high moor peats do not contain nutrients at all (*Terbe*, 1997). In Hungary, the pedological conditions favour the developing of low moor peats. The reaction of low moor peats is neutral, they are more humificated and contain more nutrients (*Forró*, 1996). In Hungary the main peat-reserves are found in the region of Hanság. The peat of Hanság is similar to high moor peats: its pH reaction is low, structure is fibrous besides its nitrogen-supplying ability is excellent (*Forró*, 1998). Besides of peat, the industrial soil mixtures contain inorganic materials (sand, clay), organic material compost and fertilizers.

In spite of the several favourable properties of peats, recently, some experiments were carried out with the aim of finding natural materials which may substitute for peat. As peat is a natural material, it is available in a limited amount for humanity (*Forró*, 1997). In addition, our peat resources are decreased considerably as a result of intensive exploitation. Peat is a reviving material, although the process of its developing is rather slow. The other limiting factor that as the laws of nature conservation will be more and more severe the conditions of exploitation will be more limited.

Some experiments were carried out with different inorganic (like rockwool, perlite and ceramic granulates etc.) (*Baudoin* et al., 1990, *Kappel*, 2003) and organic (like bark, mesocarp of coconut and composts etc.) (*Flegmann Raymond*, 1977, *Atiyeh* et al., 2000) media. The use most of these media have spread in horticultural production. There are promising results in connection employing barks in horticulture (*Nagy*, 1980, *Khaled Nagy*, 1993, *Imre*, 1997). These new types of growing substrates just hold the roots of plants, the other functions of soils are regulated by man.

Recent ideas are aiming at utilising wastes of agriculture and food industry in horticultural production as soil mixture components (*Fischer*, 1986, *Remmers*, 1989).

Method and material

We set up our experiment in a 300 m^2-size plastic house Type: Filclair of the Halásztelek Reformed Vocational School in 2002.

The test plant was green pepper (*Capsicum annuum* L.), variety Danubia, an early maturing hybrid with indeterminate growth habit. Its foliage is medium-green coloured, its crop is cone-shaped and white-coloured with sweet taste. It is resistance to TMV. During its growing we have to provide continuous nutrient-supply. This variety demands frequent picking.

We sowed the seeds in rockwool trays in January, then we planted the transplants with 5–6 leaves in pots in March. Plants were transplanted in April to the plastic house, there we planted green peppers in 12 litre plastic containers. The 8-types of growing media are designed: 1. Vegasca, industrial soil mixture for vegetables, 2. communal compost, mixed-compositioned made from plant remains, domestic and industrial waste, 3. plant-originated compost made from just plant remains and mixed with sand in 50–50, 4. pine bark - with 1–20 mm pore-size constituents, 5. low moor peat, 6. high moor peat, 7. low moor peat mixed with high moor peat in 50–50, 8. low moor peat mixed with high moor peat and bentonite in 45–45–10. We set up 4 replications with every medium.

During the experiment, we examined the plants and their soils, too. We took soil samples every month from the full depth of containers and analysed them in laboratory. We determined the pH (in H_2O), the hydrolizable nitrogen content, the organic matter content (%) and the quality of humus materials (Q) in soil samples. The value of Q expresses the stability of humus materials, if Q>1 it means that stable humus materials are in higher ratio in the soil. We carried out the laboratory analysis of soil samples according to *Buzás* (1998).

We measured the weight and volume of every crop, we gave the number of pieces and sorted them.

During the growing we have done the following works:

Pruning: one main stem was left and led it around the supporting string as it grew during the vegetation period, other branches were cut back (*Balázs,* 1994), the shrivelled or infected leaves were removed, too.

Nutrient-supply: the plants were watered daily with nutrient solution. The composition changed according to the developing stages of plants N, P, K-predominanced. From July, calcium-nitrate was added to the nutrient solution (*Terbe* 2001).

Plant protection: the plants were sprayed every week or every two weeks with different fungicides (Fundazol, Amistar) and insecticides (Actara, Vertimec). We used Kasumin for prevention bacterial diseases.

Results

The pH-values of the examined soils were different. We found that the reaction of peat-based soil mixtures were reduced in a slighter degree as a result of the daily watering with nutrient solution. In those peat mixtures, we added bentonite (in 10%) to the peat, pH values did not change. The reaction of pine bark and plant-originated compost were also stable *(Table 1).*

Table 1 The changes of the pH values in different media

Growing media	pH H_2O			
	June	July	August	Sept.
Vegasca	8.1	7.1	7.0	6.9
Communal compost	7.3	7.2	7.2	7.1
Plant-originated compost	–	7.5	7.5	7.7
Pine bark	6.7	6.7	6.6	6.7
High moor-peat	5.3	5.1	5.0	5.4
Low moor-peat	6.5	6.6	6.5	6.4
Peat with bentonite	6.4	6.5	6.7	6.7
Low moor-high moor peat	6.5	6.3	6.3	6.3

Table 2 Changes of the hydrolizable-nitrogen content at different media

Growing media	Hydrolizable-N content (mg/100g soil)	
	June	July
Vegasca	50	85
Communal compost	133	158
Plant-originated compost	–	153
Pine bark	26	27
High moor-peat	268	290
Low moor-peat	234	271
Peat with bentonite	181	246
Low moor-high moor peat	225	284

Table 3 The change of organic matter content and humus quality in media

Humus quality	Growing media content (%)	Organic matter Q
Vegasca	44	2.3
Communal compost	44	9.1
Plant-originated compost	51	15.6
Pine bark	65	0.6
High moor-peat	76	1.0
Low moor-peat	78	1.5
Peat with bentonite	58	0.8
Low moor-high moor peat	76	1.2

The hydrolizable-nitrogen gives that nitrogen amount, which is available for plants. According to our results, the highest hydrolizable-nitrogen content was measured in peat-based mixtures. In the examined period, the amount of this nitrogen form did not diminish as an effect of a continuous N-supply of the nutrient solution *(Table 2).*

The highest organic matter content was measured in peat-based mixtures and in pine bark *(Table 3).* Composts had the highest Q value. The Q values of composts are usually about 1–1.5, but we measured 9–15 *(Table 3).*

We found that the most developed plants were grown in peat-mixtures and pine bark. The plants which were grown in low moor-high moor peat mixtures and low moor peat mixtures gave the highest yield *(Figure 1).*

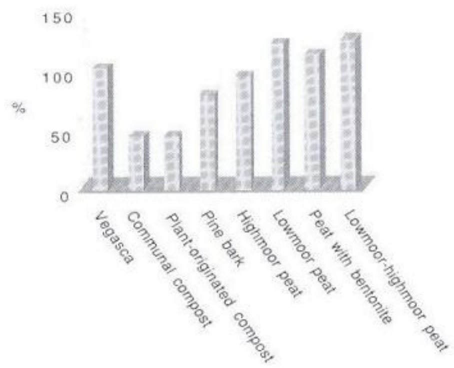

Figure 1 Yield depending on the different media

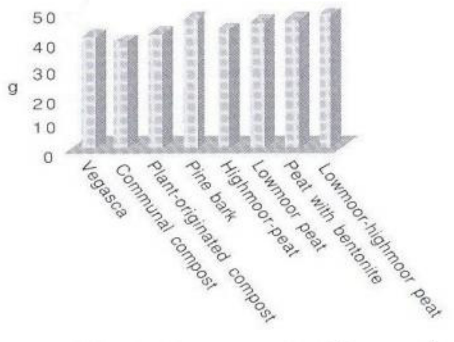

Figure 2 Average weight of fruits grown on the different media

We could pick the largest fruits from the plants which were grown in peat mixtures and pine bark *(Figure 2)*.

It was interesting that the plants which were grown in composts fell short of our expectations in developement and in yield, too. Among the peat-based mixtures we found the most fruits affected by tiprotting on those plants which were grown in high moor-peat. This disorder occurs when there is Ca-deficiency in soils (Pedryc, 1998). This result is in connection the low lime-content of high moor-peats. The rotting of the fruits from the stigma point also indicates this deficiency *(Figure 3)*.

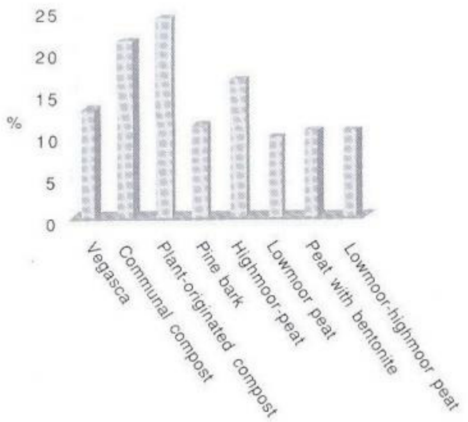

Figure 3 The frequency of tiprotting in fruits grown on the different media

Discussion

The pH-values of peat-based soil mixtures were reduced slightly as an effect of the daily watering with nutrient solution. The exception was the mixture where we added bentonite (in 10%) to the peat. Bentonite is a clay mineral with high adsorption- and buffer capacity therefore bentonite partly neutralizes the effect of the fertilizers. The use of different fertilizers usually reduce the pH values in soils.

According to our results, the highest hydrolizable-nitrogen content was measured in peat-based mixtures. Parallel to it, the highest yield was found also in peat-based mixtures.

Composts had the highest Q value. It means that the quality of humus compounds was the best in composts. In spite of it, the plants grown in composts did not give high yield. According to us, the humus materials absorbed a significant amount from the available nutrients of the composts. As a result of it, there was just a little amount of nutrients available in the composts. These plants lagged behind in developement and gave low yields.

The Q value of composts are about 1–1.5, but we measured 9–15. In case of the communal compost, the reason of it was that we extended its maturing period over one year. In case of plant-originated compost, it is related to the good-quality of raw material and the precise technology of handling. With the use of these methods we improved the quality of composts and the intensity of humification.

The quality of composts are fluctuating, their utility depend on the quality of raw materials and the appropriate handling during the manifacturing process.

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References

Atiyeh, R. M., Edwards, C. A., Subler, S. Metzger, J. D. (2000): Earthworm-processed organic wastes as components of horticultural potting media for growing marigold and vegetable seedlings Compost Science and Utilization 8:3 215–223.

Balázs S. (ed.) (1994): Zöldségtermesztők kézikönyve Mezőgazda Kiadó Budapest

Baudoin, W. O., Winsor, G. W. Schwarc M. (1990): Soilless culture for horticultural crop production FAO Plant production and protection paper 101.

Buzás I. (ed.) (1998): Talaj- és agrokémiai vizsgálati módszerkönyv 2. A talajok fizikai-kémiai vizsgálati módszerei Mezőgazdasági Kiadó, Budapest

Fischer, P. (1986): Möglichkeiten und Grenzen für den Ersatz von Torf im Gartenbau und zur Bodenverbesserung. Telma 16: 221–233.

Flegmann, A. W. George Raymond, A. T. (1977): Soils and other growth media – AVI Publishing Company INC Westport Connecticut

Forró E. (1996): Tőzegalapú földkeverék mineralizálódása meszezés hatására fólia alatti paradicsomtermesztésben – Hajtatás, korai termesztés A KEÉ Zöldségtermesztési Intézetének Tanácsadója, 27 (4): 5–8.

Forró E. (1997): Fosszilis nitrogénkészletünk, a tőzeg kertészeti hasznosításának és védelmének ellentmondásai XI. Országos Környezetvédelmi Konferencia Siófok 227–235.

Forró E. (1998): Nitrogen investigations in peat based artificial soils under plastic house Agrokémia és Talajtan 47 (1–4): 245–252.

Imre Cs. (1997): Ha elfogy a tőzeg, jön a farost? Új kertgazdaság 3 (2): 80–82.

Kappel N. (2003): Egy új közeg a palántanevelésben SZAB Kertészeti Munkabizottságának Tudományos Ülése – Integrált kertészeti termesztés 17–21.

Khaled, K. A. Nagy J. (1993): A konténeres paradicsomhajtatás terméseredményeinek vizsgálata – Hajtatás, korai termesztés KÉE Budapest 2.

Nagy J. (1980): A konténeres zöldségtermesztés Magyar Mezőgazdaság 35 (49): 8–9.

Pedryæ A. (1998): A kalciumhiány oka és megszüntetésének lehetőségei AgrEvo Kft. Budapest

Remmers, W. (1989): Die Verwendung organischer Sekundar Rohstoffe neue Aufgaben für die Torf und Humusforschung Telma 19: 101–111.

Terbe I. (1997): Szaporítóföldek és tápkockaföldek Új Kertgazdaság 3. (2): 74–79.

Terbe I. (2001): Tápanyagutánpótlás és öntözés In: Mártonffy–Rimóczi: A zöldségfélék palántanevelése Mezőgazda Kiadó Budapest