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# PRELIMINARY STUDIES ON THE SELECTION AND PREPARATION OF SUBSTRATES FOR CULTURE IN POTS AND CONTAINERS

## STUDII PRELIMINARE PRIVIND ALEGEREA ŞI PREGĂTIREA SUBSTRATURILOR PENTRU CULTURA LA GHIVECE ŞI CONTAINERE

***GACHE (LUNGU) Mirabela[1], MUNTEANU N.[1*], STOLERU V.[1], TELIBAN G.C.[1], HANGAN (ISTRATE) Roxana[1]***
[*]Corresponding author e-mail: nmunte@uaiasi.ro

***Abstract.*** *The paper presents a study on the main pedological, agrochemical and biological indices of the different types of substrate used for growing vegetables in pots and containers in order to optimize the growth and development of plants. The researche were carried out in an experimental field set up at the Didactic Center of the University of Agricultural Sciences and Veterinary Medicine Iasi. Three types of substrate were used: S1 - substrate made from 35% garden soil, 35% compost, 20% peat, 10% sand and pearlite, S2 - substrate made of earth 35% garden, 20% compost, 35% peat, 10% sand and pearlite; S3 - commercially available substrate. Determinations have been made on: nutrients, pH, humidity and granulometry. Substrate quality assessment was performed on the basis of yield and harvest quality.*
**Key words**: substrates, quality, productivity

***Rezumat:*** *Lucrarea prezintă prezintă un studiu asupra principalilor indici pedologici, agrochimici şi biologici a diferitelor tipuri de substrat folosite pentru cultivarea legumelor în ghivece şi containere, în vederea optimizării regimului de creştere şi dezvoltare a plantelor. Cercetările au fost efectuate într-un poligon experimental amenajat la Stațiunea Didactică a Universității de Ştiințe Agricole şi Medicină Veterinară Iaşi. Au fost folosite trei tipuri de substrat: S1- substrat standard existent în comerț, S2- substrat realizat pe bază de pământ de grădină 35%, compost 35%, turbă 20%, nisip şi perlit 10%, S3- substrat realizat din pământ de grădină 35%, compost 20%, turbă 35 %, nisip şi perlit 10%. Au fost efectuate determinări privind: elementele nutritive, pH, umiditate şi granulometrie. Evaluarea calității substraturilor a fost realizată pe baza productivității şi calității recoltei.*
**Cuvinte cheie:** substrat, calitate, productivitate

## INTRODUCTION

The substrate is a mixture of different types of soil, minerals and garden soil, adapted to the culture of a plant type or group of plants. The nutrient substrate plays an extremely important role in achieving a successful crop in pots and containers. For this reason, the substrate has to meet certain characteristics: to

[1]University of Agricultural Sciences and Veterinary Medicine Iasi, Romania

have a suitable structure to ensure gas exchange with the atmosphere, porosity, be permeable to water and air, be rich in nutrients and not contain phytopathogenic microorganisms (Greenwood, 2008). Recent concerns about substrates have prompted many researchers to investigate available alternatives. The use of organic waste and compost in pots substrates provides efficient and environmentally friendly solutions. The substrates are organic materials, used in many types of crops, because they provide the necessary nutrients for the plants and support the roots that assure the taking of these nutrients. An important property of these soil types must be that which provides a good water and nutrient capacity that is gradually released, significantly improving plant growth conditions. In horticultural practice, the term crop substrate means the material support in which plants develop their roots and which constitute the main source of food (Gedda, 2007). Burnett *et. al*. (2016) also showed that the use of complex organic materials as a substrate for vegetable plants has been established as a common horticultural practice. Many growers choose to prepare their own substrates for crops in pots and containers (Gache *et al.,* 2017). Substrates can be made up of different components, such as peat, coconut, perlite or vermiculite. In addition, many other components can be used in the preparation of substrates such as compost, manure, wheat straw (Treadwell *et al.,* 2011).

## MATERIAL AND METHOD

The researche were carried out in an experimental field set up at the Didactic Center of the University of Agricultural Sciences and Veterinary Medicine Iasi. Two experiences, such as pots and containers, were organized. The culture vessels were of different sizes and were categorized as containers, those of 60 liters and 25 liters and pots of 5 liters and 2.5 liters. For the pots experience, the following vegetables were used: *Capsicum annuum* L. (Medusa cultivar), salad, *Lactuca sativa* L. - (cultivar Lollo bionda), parsley, *Petroselium crispum* (Mill.) - (Mohafodrozatu cultivar) *Ocimum basilicum* L. (cultivar Aristotle), dill *Anethum graveolens* L. (Common cultivar) and *Satureja hortensis* L. (Thymian cultivar). For the container experience the following vegetable species were established: tomatoes (cherry type) - *Lycopersicon esculentum* Mill. (Aristan Purple cultivar), *Capsicum annuum* L. (Brilliant cultivar), *Phaseolus vulgaris* L. convar. communis (Aurie Bacau cultivar), *Phaseolus vulgaris* convar bean. Nanus - (cultivar Unidor) the lioness - *Levisticum officinale* Koch (cultivar Communis), oregano - *Origanum vulgare* (Italian cultivar). The placement of species in design has been done so that field have ornamental value and low risk of disease and pest attack (Galea *et al.,* 2017; Galea *et al.,* 2018; Hamburdă *et al*., 2014; Hamburdă *et al.,* 2016; Kluckert, 2005; Teliban *et al.,* 2016).

Three types of substrate were used: $S_1$- substrate made from 35% garden soil, 35% compost, 20% peat, 10% pearl and pearlite, $S_2$- substrate made from 35% garden soil, 20% peat 35%, sand and perlite 10%. $S_3$ -standard commercial substrate. Preparing the substrates is an absolutely necessary link for the vegetable species when setting up crops in pots and containers. In order to achieve a successful culture in pots and containers, we used the following components in the preparation of the substrate: garden soil, compost, peat, sand and perlite. Two types of substrate were made ($S_1$ and $S_2$) with the same materials but different quantities. The $S_1$ substrate contains: 35% garden soil, 35% compost, 20% peat, 10% sans l and pearlite, $S_2$-substrate made from 35% garden soil, 20% compost, 35%, sand and pearlite 10 %. $S_3$ -standard commercial substrate (fig. 2).

Preparation of the substrates was done manually, on a flat, well-cleaned surface. Components must have been sifted before use with a netstick small mesh, after which they were measured in volume units (buckets) and placed in alternate layers in a conical heap. Mixing was done by shaking the materials, starting at the base, thus building two smaller heaps. In the end, a bunch of things was restored the initial one from which no component, a very homogenized mass, could be chosen (fig. 1). A series of nutrient, pH, humidity and granulometry analyzes were performed for the three substrate types ($S_1$, $S_2$ and $S_3$). The analyzes were analyzed in the perspective of the Office for Pedological and Agrochemical Studies in Iasi. Substrate samples were taken in the laboratory and conditioned for analysis by drying in well-ventilated rooms or with heating systems up to a temperature of 40 °C, then increased or ground to a particle size less than 2 mm.

To determine the humus and microelements content, extra processing was done by removing root crop residues by fine milling. The determinations were made according to the standardized or officialized methods in our country. In determining the substrate reaction, respectively, the pH, was potentiometrically determined in aqueous suspension (10 g soil / 25 ml bidistilled water, with a combined glass electrode - calomel). Humidity was determined by heating at 105 °C. The content of the alkaline earth carbonates was determined by the method of the gazevotumetric method - the Scheibler method. Humus was determined by wet titration (Walkley-Black) method. Mobile phosphorus was determined by the Egner-Rielhm Domingo method and colorimetric molybdenum blue, Murphy-Rieley method (ascorbic acid reduction). Potassium (mobile) extracts by the Egnur-Rielmn Domingo method and flame photometry dosing. Organic matter was determined by the method of losing to calcination (Lăcătuşu, 2006).

## RESULTS AND DISCUSSIONS

### 1. Results on the content of nutrients, pH, humidity and granulometry of analyzed samples ($S_1$, $S_2$ and $S_3$).

*Table 1*

**Evaluation of substrates (S1, S2 and S3) on pH, humidity and nutrient content**

| No. | Samples analyzed | S1 | S2 | S3 |
|---|---|---|---|---|
| 1 | **pH** | 8.00 | 7.78 | 5.82 |
| 2 | **Humidity (U%)** | 7.52 | 7.60 | 10.4 |
| 3 | **Clay (%)** | 37.3 | 30.9 | 20 |
| 4 | **Organic matter %** | 25.0 | 25.8 | 65.8 |
| 5 | **Humus %** | 12.7 | 11.8 | 7.9 |
| 6 | **C org. %** | 7.29 | 7.12 | 4.3 |
| 7 | **$CaCo_3$ %** | 4.48 | 4.32 | 2.4 |
| 8 | **$P_{Al}$ %** | 275.5 | 268.5 | 37.5 |
| 9 | **$K_{AL}$ ppm** | 1225 | 1300 | 235 |

Analytical values obtained in the laboratory are interpreted in accordance with the limits of nutrient soil / substrate levels, based on experience with vegetable plants. Thus, the results obtained for the determination of the substrate reaction were: $S_1$ - pH = 8.00; $S_2$-pH = 7.78; $S_3$-pH = 5.82. The results obtained with the water content (u) of the substrates presented are: $S_1$ - u = 7.52%; $S_2$ - u = 7.60% and $S_3$ - u = 10.4%. The results of clay content: $S_1$ - clay = 37.3%; $S_2$ -clay = 30.9%; $S_3$-clay = 20%. The organic matter in the substrate is appreciated according to their texture, so the results obtained from the determinations were: $S_1$ - M.O. = 25.0%; $S_2$ - M.O. = 25.8%; $S_3$- M.O. = 65.8%. By determining the humus content, the productive potential of these substrates is highlighted as it contains most of the organic nitrogen in the substrate. The results obtained are: $S_1$ - humus = 12.7%; $S_2$ - humus = 11.8%; $S_3$- humus = 7,9. Results obtained in Corg determination: $S_1$-org. = 7.29%; $S_2$ -C. org. = 7.12%; $S_3$- Corg. = 4.3. $CaCO_3$ content obtained for $S_1$-$CaCO_3$ = 4.48%; $S_2$ - $CaCO_3$ = 4.32%; $S_3$-$CaCO_3$ = 2.4.

It is important to know the supply status of phosphorus and potassium assimilation substrates as they are among the essential elements of the production. The following results were obtained for the $P_{AL}$ - $S_1$ - $P_{AL}$ = 275.5 ppm; $S_2$ - $P_{AL}$ = 268.5 ppm; $S_3$-$P_{AL}$ = 37.5 ppm, and in the determination of $K_{AL}$ the following results were obtained $S_1$ - $K_{AL}$ = 1225 ppm; $S_2$ - $K_{AL}$ = 1300 ppm; $S_3$-$K_{AL}$ = 235 ppm. Substrate quality assessment was determined by nutrient rich content. The experimental results are shown in table 1.

**Fig. 1** Land mixes (original photo)


**Fig. 2** Standard commercially available substrate ($S_3$) (original photo)

**2. Results on substrate influence ($S_1$, $S_2$ and $S_3$) on productivity**

The research results obtained from the above study showed that the substrates used for potting and container culture were significantly influenced from a quantitative and qualitative point of view. The influence of these crop substrates has been highlighted in terms of productivity and harvest quality.

The substrate factor for both container experience and pots experience has led to differences in production. The variance analysis shows that production differences are due to the composition of the substrates. The experimental results are shown in table 2.

*Table2*

**Substrate results (S1, S2 and S3) on productivity**

| Experience 1 CONTAINERS | | | Experience 2 POTS | | |
|---|---|---|---|---|---|
| **No.** | **Substrate** | **Prod. total/pl obtained (g)** | **No.** | **Substrate** | **Prod. total/pl obtained (g)** |
| 1 | $S_1$ | 787.8 | 4 | $S_1$ | 173.7 |
| 2 | $S_2$ | 761.3 | 5 | $S_2$ | 149.3 |
| 3 | $S_3$ | 711.4 | 6 | $S_3$ | 108.1 |
| **Average experience** | | **786,8** | **Average experience** | | **143,7** |

The most important substrate that particularly influenced productivity was substrate $S_1$, which had in its composition 35% garden soil; 35% compost (80% vegetable compost + 20% broth); 20% peat; sand + perlite 10%. At the opposite end there is the standard $S_3$ commercial mix consisting of loamy celery, peat and sand, in which case the smallest production was obtained.

## CONCLUSIONS

1. The dynamics of plant growth and growth in pots and containers has been strongly influenced by the composition of nutrient substrates.
2. Substrate quality assessment was determined by nutrient rich content.
3. Vegetable crops grown in pots and containers on substrate S1 recorded the best yields compared to those grown on substrates S2 and S3.
4. Experimental production values have highlighted the importance of the composition of the substrates, the most important composition being compost.

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