Differential Fertilization and Nutritive Substrates Effect on the Flowering Degree of Pelargonium Zonale

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Abstract. This paper presents researches regarding the effect of differential fertilization and nutritive substrates on the flowering degree of Pelargonium zonale species. Aim of this subject research resulted from the desire to conduct experiments that provide results with beneficial impact on geraniums crop, results allowing production of some quality plants, both in terms of aesthetics and plant health. Research followed the effect of differential fertilization and of nutritive substrates on the degree of geraniums flowering. The research focused on experiments designed to highlight favourable combinations of soil and fertilizer for geraniums development and particularly, favourable for flowering (the main ornamental quality). The types of substrate, fertilizers, pH varies depending on the type of crop, the substrate and the source of fertilizer and can be affected by the source of water and the type of irrigation system. Relative acidity or alkalinity of the substrate type affects directly the availability of nutrients in the plants root system. By applying the fertilizers, amendments and culture technology can be changed, to a large extent, the direction of the chemical and biochemical process from soil as well as the fertility status.

Keywords: Geranium, fertilizer, experiment, soil, combination

INTRODUCTION

Geraniums are popular greenhouse and home-landscaping plants. To date, there are over 280 natural species identified, most originating from the Capetown region of South Africa, plus many more hybrid cultivars that have been introduced in the United States and in the United Kingdom (Taylor, 1998; Fonteno, 1992). The family Geraniaceae consists of five genera, including Pelargonium, the common geranium. Pelargonium genus (family Pelargoniiaceae) comprises about 300 species, most of them native to South Africa. The most common use of the Pelargonium genus is for ornamental purposes in pots (pots, or other types of vessels) (White, 1993). Pelargonium species are grown due to the color, flowers, scented foliage and exotic shape of the leaves. In terms of decorative, the hybrids of the Pelargonium zonale species are the most important from the variety of species belonging to the genus Pelargonium. Another important group in terms of ornamental consists in species of Pelargonium peltatum hybrids, also known as the ivy geraniums.

Among flowering plants, these geraniums represents a substantial part of the demand on the market (Horn, 1994). Geraniums are grown, either by conventional germination of seeds or by vegetative propagation (White, 1993). Due to the low fertility of these plants, methods of improvement through conventional breeding requires long periods and raise difficulties (Kubba and Tilney-Basset, 1981). Geraniums are often used in replacement of the flower species that ensures the spring decor. In the past twenty-five years were placed on the commercial market a large number of hybrids of geraniums derived from seeds. Those dealing with multiplication and the producers reacted to the modification of the consumer demands by offering a wide range of geraniums (colors and various forms of the foliage and flowers).
The paper had three main objectives as follows:
1. Determining how the plant develop according to the type of the soil used;
2. Establishing the influence of the type of fertilizer on plant development;
3. The degree of flowering of the plant according to the soil and fertilizer.

The research results will provide basic information about the geraniums fertilization, will help understand their fertilization requirements in order to improve the fertilization programs to obtain valuable productions from ornamental point of view. Currently, fertilization is based on macro and micronutrients concentration, growing medium and irrigation water quality.

In case when cultivar (and not only the species) has an effect on rooting medium and the effect varies in time, this factor must be taken into account in the fertilization process. Therefore the results of research refer both to the two studied species of geraniums (Pelargonium zonale and Pelargonium peltatum) and at the varieties (Pelargonium zonale "Savannah Coral", Pelargonium zonale "Savannah White", Pelargonium peltatum „Atlantic Ville de Paris Strawberry”, Pelargonium peltatum „Atlantic White”). The production of the quality geraniums requires great attention to detail. Therefore, research focuses on experiments designed to provide results intended to complement existing scientific information on the fertilization of a number of ornamental species belonging to the genus Pelargonium. A suitable model of fertilisation of the plant grown in the greenhouse is essential in the production of high quality plants. Certain nutrients (such as calcium and magnesium) may be mixed into the growth medium prior to planting, but the more nutrients are applied after planting using water-soluble fertilizers.

MATERIAL AND METHOD

Research has focused on experiments designed to highlight favorable combinations of soil and fertilizer for the geraniums development and particularly favorable to flowering (the principal ornamental quality). The ultimate goal of the research is to formulate conclusions that will allow efficient selection of substrates and fertilizers for the geraniums crop.

The basic property, which distinguishes the soil from rock, is the fertility of the soil that represents the qualitative character independent from the level of quantitative development. Another aim of the research presented in this paper is to provide relevant information for the geraniums producers which favors the achieving of a healthy crop with the real ornamental qualities and economically efficient. In the experiments were considered for the study two varieties of the species Pelargonium zonale and Pelargonium peltatum.

The two varieties of Pelargonium zonale species are:
- *Pelargonium zonale* „Savannah Coral”;
- *Pelargonium zonale* „Savannah White”.

The varieties of *Pelargonium peltatum* species considered for study are:
- *Pelargonium peltatum* „Atlantic Ville de Paris Strawberry”;
- *Pelargonium peltatum* „Atlantic White”.

In the experiments, have been used four types of substrates in order to determine the influence of the substrate along with the type of fertilizer on the flowering of studied *Pelargonium* varieties. Types of substrates used are named and described as follows:
- Substrate I - peat standard TS3 + clay;
- Substrate II peat;
- Substrate III - peat leaves;
- Substrate IV - garden soil.
In the experiments have been used three types of fertilizer: Atonik, Osmocote and manure. Experiments were organized in 2010-2013 and placed in the greenhouse built on a private property in Poieni area, Cluj county on a field uniform as fertility and microrelief. The research was conducted as an multifactorial experiment with the following experimental factors:

- Factor 1 – The varieties of *Pelargonium zonale* and *Pelargonium peltatum* species;
- Factor 2 – Rooting substrate;
- Factor 3 – Type of fertilizer.

From the combination of the three experimental factors were obtained 32 experimental variants, denoted by V1, V2 ..., V32. Therefore, were followed the factors of the experiment and the interaction between them as well as their influence on the varieties of *Pelargonium zonale* and *Pelargonium peltatum* included in the survey. The experiments were organized as follows: three repetitions for each variant: 3 * 32 variant; for the variant variety / garden soil / manure were studied six repetitions for each variety of *Pelargonium*.

It was analyzed the influence of fertilization on the following characteristics of the studied species: number of leaves, number of flowers, height, crown diameter. Were analyzed these characters because all have influence on the ornamental appearance of the analyzed species.

**RESULTS AND DISCUSSIONS**

Comparisons between experimental variants (type of fertilizer + substrate + species), namely the comparison of the influence on the number of flowers, number of leaves, height and crown diameter in the case of the *Pelargonium peltatum* cultivar “Atlantic Strawberry Ville de Paris” shows that:

- is observed that the best effect on the number of flowers has the fertilization with Atonik on the substrate S1 and the lowest number of flowers was obtained in the case of fertilization with Atonik on the substrate S3 (Fig. 1).

![Fig. 1. The comparison of the substrate and fertilizer influence on the number of flowers](image)

- the best effect on the number of leaves it has the combination fertilizer Osmocote + S2 (peat), manure + S4 (garden soil); the lowest values were obtained with the combination fertilizer Atonik + S3 (peat leaves) (Fig. 2).
in the case of the height the best results are obtained by fertilization with manure and Osmocote using S4 substrate (garden soil) and S3 (peat leaves) (Fig. 3);
- diameter of the crown is positively influenced in particular by the Atonik and Omcocote fertilization and the use of the substrates S1 (peat standard TS3 + clay) and S2 (peat) (Fig. 4).
In the case of the *Pelargonium peltatum* cultivar "Atlantic White", the results show that:

- the best influence on the number of flowers has Atonik fertilizer in combination with substrate S1;
- the lowest number of flowers at *Pelargonium peltatum* “Atlantic White” was obtained from variant that used manure and garden soil (Fig. 5).

![Fig. 5. Pelargonium peltatum „Atlantic White” - the comparison of the substrate and fertilizer influence on the number of flowers](image1)

- the best influence on the number of leaves has the fertilizer Atonik and the substrate S2; the lowest number of leaves was obtained using manure and garden soil;
- the highest values on height were obtained from the application of Atonik fertilizer and the use of substrate S1;
- crown diameter was positively influenced by the Atonik fertilizer application on the substrate S1 (Fig. 6).

![Fig. 6. Pelargonium peltatum „Atlantic White” - the comparison of the substrate and fertilizer influence on the crown diameter](image2)
The data obtained from the experiments having as experimental factor the *Pelargonium zonale* cultivar “Savannah Coral” emerge following:

- that the best effect on the number of flowers has the fertilization with Atonik on substrate S2;
- the lowest number of flowers was obtained in the case of the fertilization with Atonik on the substrate S3 (Fig. 7).

- the best effect on the number of leaves it have the combination manure + S4 (garden soil), the lowest values were obtained with the combination Osmocote + S3 (peat leaves).
- in the case of the height the best results are obtained by fertilization with Atonik, using the substrate S2 (peat);
- diameter of the crown is positively influenced in particular by the Atonik and Osmocote fertilization and substrates S1 (peat standard TS3 + clay) and S2 (peat) (Fig. 8).

The results regarding the influence of fertilizers and substrates included in experiments on *Pelargonium zonale* cultivar “Savannah White” shows that in terms of the height the best results were obtained with substrate S1 and Osmocote fertilization. Manure
and the substrate S4 (garden soil) positively influenced the number of leaves. The large number of flowers was obtained in the case of Osmocote fertilization on the substrate S1 (Fig. 9). The highest values on crown diameter were obtained in the case of fertilization with manure and the use of garden soil (Fig. 10).

![Graph showing flower number comparison](image)

**Fig. 9. Pelargonium zonale “Savannah White” - the comparison of the substrate and fertilizer influence on the number of flowers**

![Graph showing crown diameter comparison](image)

**Fig. 10. Pelargonium zonale “Savannah White” - the comparison of the substrate and fertilizer influence on the crown diameter**

In contrast to other ornamentals, recently rooted zonal and ivy geranium cultivars do not grow well when initially fertilized with higher levels of NH4-N (Mengel and Kirkby, 1979; Biamonte 1993).

The fertilizer formula most commonly used to produce geraniums delivers 20% N - 4.4% P - 16.6% K - 0.15% Mg - 0.1% Fe as (FeEDTA) - 0.56% Mn - 0.2% B - 0.16% Zn - 0.1% Cu - 0.1% Mo at each fertigation. In most greenhouses, the pH and water alkalinity can fluctuate widely in the irrigation water and can limit the solubility of micronutrients in the media. Peat-Lite™ formulations contain higher concentrations of chelated micronutrients to
prevent precipitation of these nutrients in the media that could reduce the availability to the plant (Bachman and Miller, 1995). The goal of most commercial greenhouse growers is to produce the maximum number of high quality plants in a relatively short production cycle. Efficient use of fertilizer maximizes the plant growth rate and utilizes the optimum ratio of macro and micronutrient fertilizers to minimize environmental and economic costs.

Research investigating nutrient uptake at specific physiological stage of plant growth and development could be used to develop more effective fertility programs based on accurately assessing nutrient uptake patterns in order to reduce nutrient losses. These types of studies have been conducted with poinsettias (Whipker and Hammer, 1997) but have not been published for geraniums. It is important for commercial growers to assess geranium fertility needs on the basis of many factors including media type, irrigation water quality and crop grown, it would be beneficial for fertilizer manufacturers to customize fertilizer formulations and programs to account for these factors in a manner that is simple and understandable for the growers to use. Controlled studies have been conducted to address various nutritional issues for impatiens (Argo and Biernbaum 1996, 1997), marigolds (Albano and Miller, 1998) and other ornamentals container crops (Fisher et al. 2001) in order to produce high quality plants.

CONCLUSION

By applying fertilizers, amendments culture technology may change largely, direction and operation chemical and biochemical processes in soil as well as fertility status. Differences in the media pH at specific stages of growth should be considered as a major factor when addressing fertility issues of ivy and zonal geraniums. In addition, further testing of all existing and new cultivars should be conducted in order to identify the plants that are more susceptible to large media pH shifts.

It can be concluded that the results were influenced in addition by the cultivar.

Even if the flowers are the main defining character in terms of decor, crown diameter and number of leaves contribute in a great extent to the overall look of geraniums. Therefore, the fertilization program should take into account all these characters.

The results of the research, presented in this paper, can contribute to the establishment of an efficient fertilization program for the culture of the geraniums, with the specification that are needed extensive studies on supplementary conditions of the culture.

REFERENCES