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USING FRUIT GROWING SPECIES FOR GREEN ROOFS

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Abstract

Green roofs are a way of landscape development that combines aesthetics with ecological functions of these types of facilities. The sustainability of this approach lies in combining economic, aesthetic and especially functional, making them the primary aspects anchored in determining the choice of the most suitable crop systems. Romania is an European country where culture tree species with ornamental value is well represented by a great diversity of species and varieties that are favorable climatic conditions for growth and flowering, while ensuring décor staggered throughout the year. A difference from the landscaping from the ground is that the arrangements of roofs and terraces rarely work with plants decorative through flowers, such as the use of tree species is more than appropriate in this case. Extending the concept of Green Roof has advantages in terms of encouraging environment, educational system and the community life, fostering solidarity population to achieve a framework for proper management of long-term spaces. Implementing the concept of green roofs in public areas can be very successful, both in the short and long term, primarily by reducing pollution and improving the aesthetics of such spaces furnished. Diversification research in this area and finding new techniques for obtaining more efficient and rapid production of a higher quality is one of the current priorities of food safety programs.

Key words*: green roof, sustainability, substrate, strawberry, optimization.*

INTRODUCTION

The issue regarding the arrangement of green roofs is relatively recently addressed both in Romania and internationally. The originality of the study basis refers to the use of fruit species for this type of arrangement.

In recent decades, architects, builders and urban planners around the world have begun to use green roofs not for aesthetic reasons - a rather secondary concern - but for their practicality and ability to mitigate the environmental extremes specific to conventional roofs.

Despite the delays due to the novelty of the theme, many communities have enthusiastically embraced the implementation of these types of roofs in public spaces (Haggas C., 2006).

Following the observations and research, it was concluded that the implementation of the concept of green roofs in public spaces can be a real success, both in the short and long term, primarily by reducing pollution and improving the aesthetics of such spaces.

The promotion of the concept of "green roof", in correlation with the already existing model of "roof garden", wants to promote new production ideas not yet exploited at full capacity so far in our country.

This implies the use of these innovative concepts, thus starting a continuous process of communication, information and counseling, worth mentioning.

With the growth of the world's population, the demand for agricultural products, which constitute the human food base, has increased and will continue to increase. It is known that in agriculture, in general and fruit growing, in particular, the cultivar, through its qualities clearly superior to the species, is the main means of production.

Diversifying research in this area and finding new, more efficient and faster techniques for obtaining a higher quality production is one of the current priorities of food safety programs.

Extending the concept of green roof has advantages in terms of encouraging environment, educational system and the community life, fostering solidarity population to achieve a framework for proper management of long-term spaces. Some of the directions investigated worldwide arising from the paper "*Quantifying the effect of slope on extensive green roof storm water retention*" by Kristin L. published in 2007 in the journal, *Ecological Engineering*, on the benefits of green roofs are:

increased water retention, reducing pollution, low noise, increased thermal insulation, sealing effective protection against ultraviolet rays action.
The presentation of other experiences with similar result, belonging to the urban communities of Vancouver and Winnipeg - Canada, Bahia de Caraquez - Ecuador, Aomori, Osaka - Japan, Nairobi - Kenya, Beijing - China, Dhakka - Bangladesh, illustrated these concerns, proposing specific solutions assumed responsibly, in accordance with the principles of sustainable urban development (Wong, N.H., Cheong, D.K.W., Yan, H., Soh, H., Ong, C.L., Sia, A., 2003; Varras, G., Vozikis, K.-TH., Myriounis, C., Tsirogiannis , I.L., Kitta, E., 2015).

MATERIALS AND METHODS

The present work is an way to make people, communities and general public aware about the advantages of green roofs cultivation in terms of environmental sustainability, development and management.
To exemplify this concept, we chose a 50 sqm roof, located in a new residential complex, on a 4-storey building in the Tatarasi neighborhood, Iasi (Figure 1).

Figure 1. Location of the project design

Exclusive advantages of a green roof: increased rainwater retention, reduction of pollution, dust particles, noise attenuation, increased thermal insulation, effective protection of waterproofing against the action of ultraviolet rays, protection of waterproofing against day/night and summer/winter temperature variations, improving the quality of life, integrating the building into the natural environment, increasing the value of the building and others (Bibbiani, C., Campiotti, A., Giagnacovo, G., Incrocci, L., Pardossi, A., Latini, A., Schettini, E., Vox, G., 2018; Olate, E., Gómez , M.F., Musalem, M., Sepúlveda , C. and Ferrer J.M., 2013).
Secondary advantages of using fruit tree species for green roofs: ensures flavor, freshness and color to site, offers a decorative spring look through flower and color, attracting pollinators and offering delicious and fragrant fruits. The surplus fruit can be used by processing in different forms. In addition, fruit growing practices can be a relaxing activity influencing the well being on all levels (Lille, T., Karp, K., Varnik, R., 2003).
Therefore, when choosing the varieties intended for this type of arrangement, several factors are taken into account, such as: varieties adapted to the climatic conditions of the area in which they are to be planted, resistant to diseases and pests, with a shallow root system and heights as low as possible, which form few and short stolons.
Being a shallow rooted annual crop, strawberry can be fitted anywhere in urban horticulture development with little but frequent irrigation facility.

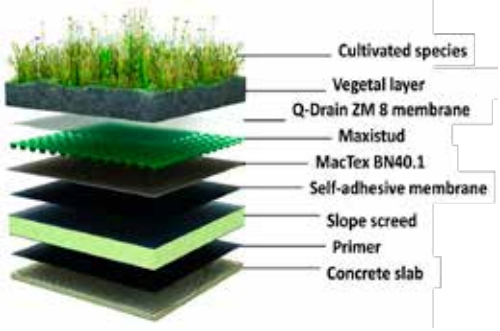

Figure 2. Layers placed in the gutters on the roof

Through its objectives, this project will not only contribute to maintaining the sustainability of the environment by maintaining the ecological balance of the area, but will also use the natural resources of climate and soil without disturbing the ecological balance (Pramanick, K.K., Kishore, D.K., Watpade, S., Sharma, Y.P., 2017).

For container mounting (Pașcu Roxana, Zlati Cristina and Bernardis R., 2017) we have used innovative materials meant to protect both the insulation of the roof they were mounted on and the cultivated plants. For good container insulation, we used a special membrane, called MacTex BN40.1 200gr, and in order to retain rainwater in the containers we used Maxistud**,** which is a membrane with tronconic protuberations of HDPE, of high thickness (20 mm) and exceptional mechanic characteristics, that can retain up to 6l of water on 1 m^2. Over this membrane, for the distribution of the substrate weight and in order to insure good water drainage, we used a Q-Drain ZM 8 membrane (Figures 2 and 3).

As planting material there will be used refrigerated stolons.

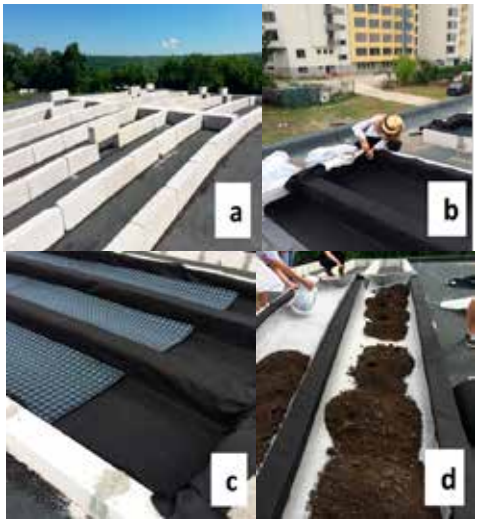

Figure 3. Containers mounting: a-BCA briks, b-MacTex BN40.1, c-Maxistud, d-Q-Drain ZM 8

Strawberry varieties description:

‘**Albion**’ is a Californian variety, high yielding, robust plants grow conical shaped berries of good flavour and excellent firmness, ideal for eating fresh. They produce multiple crops and are usually available throughout the summer months (from May to September).

‘**San Andreas**’ strawberry is a moderate day-neutral with a production pattern very similar to Albion. Plant vigour for ‘San Andreas’ is somewhat higher than for ‘Albion’ early in the season, but berry size throughout the fruiting season is similar to ‘Albion’. The fruit colour for ‘San Andreas’ is slightly lighter than for ‘Albion’, and it has similar post harvest characteristics. The flavour of ‘San Andreas’ is very good and it also shows good disease resistance.

RESULTS AND DISCUSSIONS

The opportunity of the study is achieved by increasing green areas in urban landscape in terms of continuous demographic growth. Landscape architecture, being directly related to ensuring the ecological balance of the environment, has as main objective the preservation and development of landscapes and their associated values for the benefit of current and future generations.

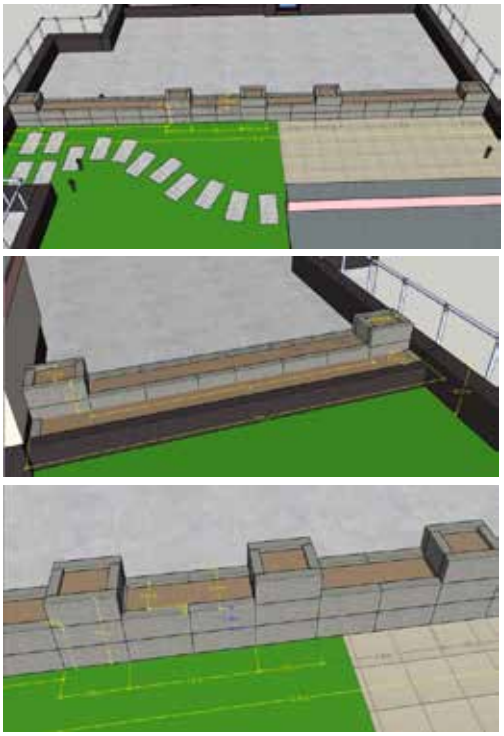

Figure 4. Space systematization for green roof project design

The sustainability of this approach lies in combining economic, aesthetic and functional aspects, especially of such areas, making them the primary aspects anchored in determining the choice of the most suitable crop systems (Figure 4).

In Romania, the ornamental culture (Cojocariu Mirela, Elena Liliana Chelariu, Chiruţă C., 2022) but also fruit trees with ornamental value is well represented by a great diversity of species and varieties that find favorable climatic conditions for growth and prosperity, while ensuring decor spread throughout the year (Torchyk, U.I., 2010). For strawberry, there are developed many culture methods that have dual role: ornamental and economically.

Many communities have embraced enthusiastically implementing these types of roof in public areas (Pradhan, S., Mitra (Sarkar), M., 2017; Rowe, D.B., 2018). Following observations and researches have concluded that implementation of the concept of roof greenery in public spaces can be very successful, both in the short and long term, primarily by reducing pollution and improving the aesthetics of space designed.

Promoting the concept of "green roof" in conjunction with the already existing model of "garden on the roof", aims to promote new ideas untapped production at full capacity so far in our country. This involves the use of these innovative concepts, such as an ongoing process of communication, information and advice noteworthy.

The scientific research addressed in this paper focused on some strawberry varieties, with the purpose of including them on green rooftop culture as a new way of cultivation (Figure 5).

Figure 5. Design proposal for landscaping the green roof garden with emphasize on strawberry

Considering the importance of green spaces, the proposed solution presents an important contribution both to the development of knowledge in the field, including novelty, originality and complexity and integration of strawberry culture in urban design (Zlati Cristina, Pașcu Roxana, 2021).
We have included in this project (Table 1) species that are also suitable for this kind of roof design and an evaluation of potential production that can be obtained. As we can observe in Table 2, the production can cover the necessity of building inhabitants. Also, the production overplus can be sold at a premium price as early or late crop.

Table 1. List of proposed vegetation, species and quantity required

Species used for roof composition	Quantity (pieces)
Abies concolor	1
Acer palmatum 'Fire Glow'	2
Berberis thumbergii 'Atropurpurea'	2
Buxus faulkner 'Ball'	2
Cupressus leylandii 'Green'	6
Cupressus arizonica 'Fastigiata'	6
Euonymus japonicus 'Aureomarginato'	3
Lavandula angustifolia	4
Ligustrum ovalifolium 'Aureum'	3
Photinia x *fraseri* 'Red Robin'	15
Rosa 'The Fairy'	4
Yucca filamentosa 'Golden'	3
*Fragaria grandiflora '*Albion*'*	35
*Fragaria grandiflora '*San Andreas'	35

Table 2. Strawberry varieties production estimation

Variety	Production per plant (grams)	Nr. of plants	Total Production (Kg)
*'*Albion*'*	800	35	28
'San Andreas'	700	35	24.5

With world population growth has increased and will further increase the demand for agricultural products which are the basis of human food. It is known that in agriculture in general and fruit growing, in particular, cultivar, by its superior qualities, is the main means of production (Kuchi, V.S., Kabir, J., 2017). Diversification of the research in this area and finding new techniques for obtaining more efficient and rapid production of a higher quality is one of the current priorities of food safety programs.

The productivity of strawberry varieties could be up to 900 grams per plant in full ripening season.
Detailed images and zoning of the design project could be observed in (Figure 6).

Figure 6. Details of the design proposal

CONCLUSIONS

The present topic is a way to raise the awarness upon the advantages of green roofs for sustainable environmental development and management.

It intertwines concerns about caring for the environment, sustainable urban development and quality of life.

Our study and the literature reviews has been proven that greening plays a very important role in building an environmentally friendly and heathy society.

Green roof as a landscape solution would serve to replace ecological functions lost in the development of the land.

Using fruit tree species for these type of landscapes will bring major benefits to environment in terms of healthy and economic aspects of life.

In the same time, the project results will increase the adoption of sustainable soil management practices in commercial strawberry small farms.

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