

ABSTRACT

Key words: Intercropping, landscaping, multifunctional, community, health

The research for elaborating this doctoral thesis with the title “**Enhancement of the ornamental value for vegetable crops in an intercropping system by design optimization**” was done between 2014-2017, in the laboratory and the experimental field of the Vegetable Section from the Faculty of Horticulture of Iasi

The aims of this thesis was the creation of several aesthetic, useful and practical vegetable gardens applying rules from landscaping design, in an intercropping system, using both vegetables and horticultural plants in designing a space for relaxation and meditation.

In order to achieve the desired outcome several main objectives were established:

1. Study regarding the possibility of realizing the association of vegetable plants in the space and time, in the eco-pedological conditions of the zone.
2. Study regarding the effect of landscaping design rules over growth, development and crops.
3. Study regarding the effects of landscaping over vegetable landscaped design.
4. Observing the influence of technological factors over some biochemical indicators.
5. Evaluating the economic efficiency of different types of landscape design.

In the process of achieving the aims and objectives that were established six distinct experiences were conducted.

The first experience, represented by a vegetable garden of 20 m², had in its components 10 horticultural species in different associations and successions. The family garden was realized in a geometric style, was easy to maintain and had multiple functions.

The second experience was represented by a vegetable garden designed for micro farms, for personal and economic use, it had a surface of 100 square meters, in a geometric style, divided by main alleys in four equal squares. The garden decorates for a long period of time due to its successive cultures. The horticultural species used are 21 in number, offering a large chromatic pallet and multiple functions. Among its most important ones the sanitary and economic come forth, due to its intercropping system used.

The third experience, bifactorial, was organized over a surface of 48 m², realized in a geometric design, in mirror. Combining vegetable species with flower ones gave a volume and color effect, which made them attraction points. The A factor, represented by methods of association, had a strong positive influence in increasing the aesthetics value of the garden and the B factor, represented by the different succession plans contributed to ensuring fresh vegetables for a long period of time.

The IV experience extended over a surface of 22.4 m² with more than 20 horticultural species, realized in a mixed style. The intercropping system used offers a spectacle in terms of nuances and perfume due to the etheric oils from basil and sage and the chromatic pallet of the plants used in the garden. The alleys are covered in decorative bark which beside the design effect also contributes to maintaining the sanitary function.

The V experience represents a vegetable garden in a mixed style, realized by associating annual plants with perennials through growing technology adapted to create a harmonious development. The garden is composed of 25 horticultural species, present as a primary/ secondary crop or as an anticipated crop.

The VI experience is organized over an area of 100 m², in a geometric style, with one central alley that divides the garden in half. Along with the design cues present from the different proposed succession

and association plans, the height of the plants play an important role in offering continuity and linking the composition plans.

The thesis is structured in two parts and ten chapters.

Part 1 – State of arts regarding ornamental growing of vegetable plants contains three chapters:

- Chapter 1: The importance of vegetable crops
- Chapter 2. Landscape design as a mean to enhance the ornamental value of vegetable gardens
- Chapter 3. Technical and organizational systems used in landscape vegetable crops
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Part 2 - Own research results contains seven chapters:

- Chapter 4. The goal and objectives of the research. Material and general work method
- Chapter 5. Study of the natural environment and organizational-administrative conditions
- Chapter 6. Results regarding the usage of landscape design in vegetable crops. Study cases
- Chapter 7. Research regarding the effect of intercropping of vegetables in different landscape designs
- Chapter 8. Studies regarding sustainability and ornamental value of the ornamental vegetable gardens models
- Chapter 9. Study of the economic rentability aspects of ornamental vegetable gardens
- Chapter 10. General conclusions and recommendations

The bibliography contains a number of 126 references from Romanian and worldwide authors.

The first part of the doctoral thesis is composed of three chapters that contain general information from relevant literature and refers to the actual state of knowledge regarding aesthetics in vegetable crops.

The first chapter of the thesis is structured in four subchapters and presents aspects such as the importance of vegetable crops from a therapeutic, health, agrotechnical, economic and aesthetics point of view and also risk factors that can appear in this types of crops.

The second chapter is divided into three subchapters that treat the history of vegetable gardening and vegetables, stressing upon the types of vegetable gardens that are currently used.

The third chapter is composed of six subchapters that discusses the range of possibilities regarding associations and succession of plants and the requirements that vegetables need from a biological and ecological stand point. Also landscaping management and design was studied in regards with vegetable crops.

Part 2 of the thesis has a number of seven chapters and contains the personal contribution based on the research activity.

The fourth chapter presents the aims, objectives, general methodology and materials used in the study.

Chapter five contains four subchapters and presents the conditions, in terms of natural space, logistics and institutions, of where the study was conducted.

The research was carried at the “Vasile Adamache” university experimental farm field. The institution had all the required facilities in order to complete the aim and the objectives traced. The pedo-climate conditions are favorable for growing vegetable crops.

Chapter six presents the results achieved by using landscaping design with vegetable crops in Romania, the principles applied, the cropping technology used and the desired vegetables species by Romanians. Based on this study cases several solutions where proposed that will contribute to improving the aesthetics value of the studied vegetable gardens.

Chapter seven shows the results obtained with regards to the influences of the experimental factors

in terms of growing and development and in terms of production and its quality. Based on the conducted experiences, over a span of three years, the results achieved contribute directly to highlighting the utility, the necessity and the impact the association and succession of plants have in the six gardens.

For Model 1 the results obtained with regards to growth and development of plants was harmonious, according to literature, biometric indicator values concurring on this result.

For Model 2, the plants, in different forms of associations and successions, showed an harmonious habitus, well developed, with a pleasant aspect and scent in case of species that have in their composition etheric oil. In the case of tomatoes the number of leaves present in between two inflorescence was of two or three, depending on the crop type, showing that they developed in suitable conditions. The weight of the fruits and their dimensions where within the specified range for their type.

Using flower plants alongside vegetables in this model lead to attracting benefic insects, actively contributing to their growth and development.

Production values from 2015 till 2017, in the case of the plants present in Model 2 where close to those mentioned in literature, except for broccoli, spinach and salad that where associated with navy beans.

In Model 3 the plants presented a well-developed habitus that contributed to the creation of a visually pleasing perspective. The biometric indexes the we followed, for example fruit diameter, their length and number of ramifications have presented average results for their specific crop.

Analyzing the production data for the plants used in M₃, their average values were different from those that are present in crop literature, the species placed in a intercropping system presented larger values, except for beans, carrots and cherry tomatoes crops.

In Model 4 the plant habitus presented average values for biometric index that were in line with what is found in horticultural literature. The height of the plants, that ranged from 2.5m – beans to 0.22 cm – chives, was used to further highlight the landscaping design plans. From a production stand point the average values obtained for chard and hot pepper where greater than the industry standard.

For Model 5 we applied the knowledge gained over the course of study years and experiments regarding the growth and development of the plants used in it. The results obtained show the impact that the intercropping system has over the crops. The biometric indexes studied in the case of perennials such as sage, sorrel or hyssop presented in the third year of growth results that lead to a good production. From this perspective the production results obtained were positive, the only exception was the bean crop whose production suffered due to draught, present during summer time.

Model 6 results for growth and plant development where specific to the crops used, the plant habitus was harmonious. Regarding the production data for this model this where in accordance with the studied literature, average results where even higher than normal for some crops, such as chard, hot pepper, basil and celery.

The results obtained regarding the biochemical composition for the eight samples studied showed that, in some cases, certain types of associations had a positive influence over the crops.

In conclusion, in all six gardens the salad showed the highest production values in association with spinach, as an anticipated crop. The beans showed its largest production in the case of Model 6 in association with Lollo Rosa salad. In the case of cherry tomatoes the best production was achieved in association with basil for the Ariston Purple, Bumble Bee and Ema de Buzau crops, followed by Beam's yellow pear in association with carrots and basil. In experimental conditions the cauliflower crop „Bulgare de zapada” had the highest values for the weight of its growth flowers in association with celery.

The results obtained regarding the chemical composition of the samples studied show values similar to those present in literature, demonstrating that the intercropping system applied to the models actively

contributes to obtaining a quality production.

Chapter 8 is structured in 5 subchapters that discuss and evaluate the different types of designs applied on the studied vegetable gardens, from a sustainability and aesthetic value perspective.

The six vegetable gardens models were evaluated by a panel of experts by applying an evaluation sheet, followed by a SWOT analysis to determine the model with the best results.

From a sustainability side the Model 3 garden received the highest marks, followed by Model 2 and 6.

From a design perspective the models showed close values, Model 6 taking first place.

To sum up, by using the intercropping system and a suitable landscape design the risk regarding disease attacks was greatly reduced. The studied vegetable gardens offer the possibility to teach the young generation in horticulture and also offers a fresh vegetable basket for a very long time.

By applying the intercropping system and the adequate design the aesthetic value of the garden grew, showing greater multifunctionality and pleasant view.

Chapter 9 treats aspects related to economic efficiency related to the vegetable gardens, and is structured in four subchapters.

Analyzing the revenue and production costs allowed us to have a correct view regarding the efficiency of this type of gardens.

From a cost perspective, the largest percentage is represented by materials, which were the highest in the first year and reduced in the following years. In conclusion, besides the aesthetic benefits these gardens have also an economic contribution.

In **Chapter 10** the general conclusions of the thesis are presented, which show that the aims and the objectives established were fully accomplished. The recommendations made are in line with the best vegetable garden models that resulted from our analysis.

In summary, based on the research done, we can state that family vegetable gardens arranged in an intercropping system represent an area of interest for both researchers and enthusiasts.

We highlight the fact that preliminary reports presented at different scientific venues were well received by experts, ornamental family vegetable gardens have distinct aesthetic value and the presented models can be adapted to different scenarios, be them in your yard, around the houses, or in allotment gardens.