

## SUITABILITY FOR URBAN AGRICULTURE AND PERMACULTURE OF SOME BIOTYPES AND NEW VARIETIES OF SPECIES WITH SANOGENE CHARACTERISTICS AND QUALITIES

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### Abstract

*According to the FAO statistics and reports (2013) in the next 30 years the world's urban population will double and more than 60% of it will live in cities. Appropriate measures will be needed to ensure food and one of the key measures that address these changes is the development of policies, strategies, techniques and appropriate support mechanisms for sustainable management system for urban agriculture/horticulture, including permaculture. In this context, it was realized multidisciplinary research at UASVM of Bucharest and based on the results obtained were recommended varieties Deea, Elita 124 and Roxia from the species Ribes nigrum L. (black currant), Rolan, Jh. Van Tets from the species Ribes rubrum L. (red currant), V2 biotype from species Lycium barbarum L. (wolfberry) and Rares, Valeria, Carmela, Viorica, Bucovina, Ilinca from species Prunus armeniaca L. (apricot) that can be grown in urban and suburban gardens. Making them suitable for the characteristics of these varieties and biotypes are referring to: earliness of fruiting, production obtained in ecological conditions, low to medium volume of shrubs and trees, plant density per unit area, self compatibility in a high proportion of gametes and quality and organoleptic characteristics, biochemical and sanogene of fruits. Among the biochemical and sanogene characteristics, dry matter levels were high (15% blueberry, 17% wolfberry and 22% apricot), vitamin C (24 mg/100 g in apricot, 60 mg/100 g wolfberry), flavonoids (1.12 mm rutin/ml currant), polyphenols (200 mg galic acid/100 g wolfberry), antioxidant capacity (48 RA% in wolfberries).*

**Keywords:** *Lycium barbarum L., permaculture, Prunus armeniaca L., Ribes sp., urban agriculture.*

### INTRODUCTION

#### • The role of urban agriculture role in re-establishing some ecological, social, economic, sustainable interrelations.

In the next 30 years, the world's population will be twice as big as it is in the present which implies the fact that the number of poor people within urban regions will also go up. The inflation of the urban population is more noticeable in developed countries as a consequence of the rural population's migration towards cities in search of food, employment and security. This changes have an accelerated trend, thus in the year 2030, 60% of the population is expected to live in the cities. This rapid urbanisation and the harsh reality of poverty have called out for the implementation

of certain strategies through which food supply may be assured and of a distribution system which can match up to the levels of the urban food insecurity. Apart from the growing food demand, the existence and spreading of poverty, unemployment, famine and malnutrition throughout the globe are problems of great interest to the central and municipal authorities.

This being the given reality, urban agriculture and horticulture (UPA/UPH) have become a key component for the survival strategies of the poor section of the urban population, while also representing an important contribution to the fresh products' supply chain.

In this context, FAO - The Food and Agriculture Organization of the United Nations has defined urban agriculture as being an

industry which produces, processes and develops the food and fuel markets as a response to the daily needs of consumers from cities or metropolises, on land or on water, along urban and suburban regions applying intensive production methods, using and reusing natural resources and urban waste in order to produce diverse crops and animal husbandry.

Urban agriculture and horticulture represent an employment and income source and have an outstanding potential to enrich the nutrition of disadvantaged people from urban areas.

Nowadays we are witnessing profound changes and the key to these changes is that of developing policies, strategies, techniques and support mechanisms which are adequate for the sustainable management of urban agriculture/horticulture. This fits into a larger picture regarding production, marketing, environmental and marketing planning of water supplies, rational water consumption and food security.

Creating and applying research strategies within the ample project of supplying food for cities asks for multidisciplinary and multi-institutional activities. Within these activities FAO (The Food and Agriculture Organization of the United Nations) has an active role through the: - development and implementation of food security Programmes; - collaboration with decision makers in order to strengthen the support capacities for developing strategies for urban and suburban agriculture; - organizing of regional workshops, such as those in Asia and South Africa, which are supported by developed countries like Norway and Belgium; - interaction with endorsing communities in order to raise funds for the consolidation of some of the countries' initiatives and for the implementation of some short and medium-term projects regarding urban agriculture/horticulture (UPA/UPH).

The multidisciplinary nature of the research, production, planning and marketing activities, in order to supply food for the cities through UPA/UPH, has made it necessary for FAO to build partnerships with other organisations which are working in this same field. Such partnerships are the FAO/WHO "Global Fruit and Vegetables for Health Initiative", IGRH, RUAF, CIRAD (French Agricultural Research

Centre for International Development), ISHS (International Society for Horticultural Science) and GHI (Global Horticulture Initiative).

At the same time, urban agriculture is a way of cutting down on carbon dioxide emissions through limiting the shipments to the consumers and through expanding cultivated areas, improving biodiversity and applying organic cultivation techniques. Urban agriculture/horticulture can substantially contribute to reducing chemical pollution and noise levels and to decreasing the number of people with diabetes and arthrosclerosis by increasing their fruit and vegetable intake.

The following cities and metropolises can be considered as models for developing urban agriculture: Havana - Cuba, Mumbai - India, Beijing - China, New York City Pomona Valley - California and Todmorden - UK.

#### ● **Permaculture, a revolution regarding the permanent ecosystems' design**

**Permaculture** is a branch within ecological design or within environmental engineering and design, which promotes sustainable architecture and keeps shaping the agricultural system to the likes of the natural ecosystem.

Permaculture deals with environmental design so as that it can be self-sustaining, according to ecological and biological principles, using mostly models which occur in nature.

**Ecological design** is defined by Sim Van der Ryn, professor at Berkeley University California and with Stuard Cowan, 2007 as a form of design that reduces the environmental impact to a minimum by integrating itself in life's processes.

In his book "Ecological Design, Tenth Anniversary Edition", edited in 2007, Sim Van der Ryn and Stuard Cowan summarize the principles of environmental design which now are being applied by more and more followers. These principles are: 1. The selection of plants and animals is done according to the place where they are bred; 2. Environmental management is a source of information for environmental design; 3. The design is done together and in accordance with nature; 4. Everyone is a ecological designer; 5. Making nature more visible to us.

Permaculture is the philosophy of working with nature, rather than against it, through its

prolonged and thoughtful observation and not necessarily the philosophy of reckless and drawn-out work. This view awakens man's capacity to study plants and animals in all the complexity of their functions, which is more efficient than treating each field as a singular productive system (Mollison, 1988).

Although Joseph Russell Smith is the first to have written about permanent agricultural systems in his book called "Tree crops", published in 1929, Bruce Charles "Bill" Mollison (born in 1928 in Stanley, Tasmania, Australia) biologist, researcher and professor at the "The Permaculture Institute in Tasmania" which he has founded, is considered to be the father of permaculture. Under his guidance, other renowned permaculture specialists such as David Holmgren and April Sampson-Kelly have been formed. David Holmgren was a close collaborator of Bill Mollison's in issues regarding agriculture, horticulture, ecology, economic systems, strategies for developing businesses and communities in accordance with these areas. As a result of their collaboration, they wrote a book called "Permaculture One" (1978). It should be noted that April Sampson-Kelly created the first on-line system called: "Permaculture visions Online Institute" in 1993 which was based on Bill Mollison's vision and which taught thousands of trainers how to grow food using the Permaculture methods.

The ethical principles of permaculture are illustrated in three main directions in Bill Mollison and David Holmgren's book "Permaculture One" from the year 1978. These are: *Caring for Earth* so as that the live systems can survive and continue to proliferate; *Caring for people* meaning that they should have access to all the resources they need in order to live; *Fair Share and limiting resource consumption* regarding the limitation of individual needs which can, in turn, allow the use of resources for following the other two directions. Also, limiting needs will create a surplus which can then be shared with other people from the community.

Permaculture is a real revolution and it can start in any of the urban or rural gardens. This revolution brings changes to the way we apply positive thinking in regard to our respect towards Earth, towards the biological comfort of plants, animals and humans, towards their

health, towards tradition and the ethics of agriculture and towards Creation as a whole.

- **The varieties and biotypes of health-promoting species seen as a link between the sustainable agriculture's elements and those of permaculture**

Creating or studying cultivars of different plant species with health-promoting properties which can fit within the permanent agriculture design is a concern that substantially contributes to the practical creation of a sustainable system.

There are people (like for example the population of Kerala, southern India or the chagga population in Tanzania) in many regions of the world who take their food from gardens with similar structures to those of natural forests. Trees and fruit trees, grapevines, shrubs, herbs and vegetables all grow together like in the woods. This type of structure, known as stratification within permaculture, allows gardens to be efficient due to the fact that several crops are simultaneously cultivated within the same space. These gardens offer the people all the food, most of the medicine and vegetable fibres they need, the opportunity of selling something and all from just a relatively small patch of land.

Nowadays, after huge territories covered with commercial orchards have disappeared and fruit "are growing" in supermarkets, urban agriculture, including urban horticulture and permaculture can be an alternative solution to supplying adults and their descendants with natural fruit.

Within this context, several interdisciplinary researches have been initiated by UASVM of Bucharest. Their main aim is finding the agro-biological and health-promoting properties and recommending certain varieties belonging to the *Ribes nigrum* L. (black currant), *Ribes rubrum* L. (red currant), *Prunus armeniaca* L. (apricot) species and certain biotypes from the *Lycium barbarum* L. (goji) species for being cultivated in urban and peri-urban gardens. Those characteristics which can make these varieties and biotypes suitable are: fruiting precocity, yield that has been obtained in organic conditions, the small or medium volumes of the shrubs and trees, the high density of plants per area unit, the high rates for the self-compatibility of gametes and the

organoleptic, biochemical and sanogene qualities of the fruit.

## MATERIALS AND METHODS

### • The natural conditions and institutional framework of the conducted research

The *Ribes nigrum* L. (black currant), *Ribes rubrum* L. (red currant), *Prunus armeniaca* L. (apricot) species and the biotypes from the *Lycium barbarum* L. (goji) species on which the present research has been focused, were planted in the experimental field within the UASVM biobase in Bucharest. The representative profile has the following geographical coordinates 44°28'10.14"N (latitudinal) and 26° 4'4.82"E (longitudinal).

Bucharest City is situated in Vlăsiei Plain, the middle section of the Romanian Plain which is bordered by the Titu-Gherghita Plain in the north, by the Bărăganul Mostiștei Plain (also known as Southern Bărăgan) in the east and south-east, by the Ialomița River in the northwest and by the lower valley of the Argeș in the west and southwest. This is a typical tubular plain, with wide and flat interfluvies.

The foundation consists of Proterozoic crystalline deposits belonging to the Vlach Platform. On top of these, there are sedimentary deposits of Paleozoic and Mesozoic age, topped by Quaternary surface materials represented by 2 to 12 m thick layers of loess on which numerous coves have formed through compacting and suffusion processes. Bucharest's Plain, a component of the Vlăsiei Plain, has an altitude of 100-115 m, in the north-western part and of 50-60 m, in the south-east where the Dâmboviței meadow is. The city itself is between 58 m and 90 m high and the Băneasa Field (otherwise known as Otopeni) is 90-95 m high, being situated north of the Colentinei Vally. Most of the landscape is that of a smooth plain.

The climatic characteristics of the experimental field are those of a temperate-continental region, defined by slight thermal excesses which tend to occur due to the high number of constructions, car traffic and industrial activities in this urban area. So, while at the outskirts of the city, the annual average temperature is 10.5°C, at the centre the average value is 12°C. In normal years, the summers

are hot, even torrid, with frequent draught episodes and winters are cold, with large snow falls, especially in the northern part of the capital. Springs are short, with ample temperature fluctuations from one month to the other and with notable day-night variations. Autumns are characterised by thermal moderation as they ensure a slow transition towards the cold season. The number of days without frost spanning between 178 and 205 and the vegetation period which is around 245 days, are usually favourable conditions for cultivating cereals, different fruit tree species – including those we have taken into study, vegetables and ornamental species. Annual precipitation ranges from 550 to 600 mm, with a peak in the May-July interval. Showers and heavy rains are frequent. Dominant circulation of air is from the east and northeast in winter and from the west in the rest of the year. The maximum wind speed is 3.5-4 m/sec. The native vegetation of this plain consists of deciduous forests with *Quercina* species, remains of the Vlăsiei Woods and with tree steppe meadows. From a pedological point of view, the predominant soil class is that of the red preluvosols which have a clayish texture, a 6.2 pH and a humus content between 2.17% and 2.6%.

### • Biological materials and methods employed

The following cultivars *Elite*, *Rolan*, *Jonkheer van Tets*, *Tatran*, *Detvan* from *Ribes rubrum* L. (red currant) species; *Tinker*, *Deea*, *Roxia*, *Elita 124*, *Abanos*, *Ksvana* from the *Ribes nigrum* L. (black currant) species; biotypes V<sub>1</sub> and V<sub>2</sub> from *Lycium barbarum* L. (goji) species and the cultivars *Rareș*, *Valeria*, *Carmela*, *Viorica*, *Dacia*, *Bucovina*, *Ilinca* from the *Prunus armeniaca* L. (apricot) species were studied.

The research methods that were employed had an interdisciplinary character, being the result of the collaboration between academics, researchers, Bachelor of Science graduates and PhD candidates. In order to emphasise the agro-biological and technological characteristics, standardised methods elaborated by the Research Institute for Fruit Growing Maracineni were used for the comparison study between cultivars.

Fruit quality has been emphasised taking into account the present views regarding quality and advanced methods through which issues such

as: quality, authenticity, the homogeneity of the biological material, standardisation of reagents, quality parameters through which cultivars are evaluated in European countries (for example: titratable acidity (TA); soluble substance content (SSC) determined using a portable refractometer (Optech, Brix 0-12% ATC); the quantification of bioactive compounds where we can include the ascorbic acid which has been spectrophotometrically determined by measuring the absorbance in the visible light field; malic acid, citric acid and sugars determined using liquid chromatography; polyphenols determined spectrophotometrically in the 705 nm visible domain, using the Folin Ciocâlteu method; total flavonoids content determined spectrophotometrically by measuring the absorbance; total antioxidant capacity determined using the indirect spectrophotometrical method, measuring the absorbance at 515 nm wave length), have all been considered (Stoica et al., 2013).

The significance of the differences between biotypes and cultivars were determined using the unifactorial analysis of variance (ANOVA). The cultivars which were best adapted to the studied region and which met the urban agriculture/horticulture and permaculture requirements were chosen by summing up their analysed positive characteristics, which have been statistically tested.

## RESULTS AND DISCUSSIONS

### ●Agro-biological and technological characteristics of the cultivars and biotypes belonging to the *Ribes rubrum* L., *Ribes nigrum* L., *Lycium barbarum* L. and *Prunus armeniaca* L. species.

The limitation of the surfaces destined for urban agriculture/horticulture and permaculture, imposes a series of restrictions regarding the characteristics of the cultivated plants, in general, and more specifically of the studied species. These restrictions are: the reduced vigour of fruit tree and shrubs species; a balanced ratio between shoots, vegetative branches and fruit-bearing branches which contribute to an earlier fruit yield, constant economical yields each year, a good adaptability to the biotic and abiotic conditions of the area, resistance to pathogens' attacks, promoting the entomofauna and the helpful

fauna, applying technologies with minimal energy consumption, mixing different cultivars and plant species in order to achieve balance in their given ecosystem and the organoleptic and sanogene quality of fruit.

### ● The vigour of the shrubs and trees belonging to the studied cultivars and biotypes

By analysing the synthetic indicator "plant volume" different aspects regarding plant growth and development can be observed. This index has been determined based on the measurements carried out on plants in their "growth and development" growth phase of their ontological cycle, in their "dormant" state and before undergoing the fructification pruning (Cociu and Oprea, 1989; Dejampour and Zeinalabedim, 2006; Bălan, 2008).

The elements on which the plants' volumes were determined were the characteristics of the geometric shape that resulted from the plants' growth (the projections of the two diameters of the goji, black and red currant shrubs on directions parallel and perpendicular to the row on which they were planted and the height of the apricot treetops and their two diameters). Next, the mathematical formulas, which corresponded to the plants' geometrical shapes, were applied (Tudor, 2010; Manole, 2013; Mencinicopschi, 2013).

The cultivars and biotypes that have been studied were found to fit into two groups: plants with a small volume, and plants that had a medium volume. The plants with a small volume were those from: the  $V_1$  goji biotype ( $0.37 \text{ m}^3$ ), the *Tatran* red currant cultivar ( $0.03 \text{ m}^3$ ), the *Roxia* black currant cultivar ( $0.09 \text{ m}^3$ ) and the two apricot cultivars *Valeria* ( $1.7 \text{ m}^3$ ) and *Rareş* ( $2.0 \text{ m}^3$ ). Medium volume plants were those belonging to: the  $V_2$  goji biotype ( $1.34 \text{ m}^3$ ), the *Elite* ( $0.08 \text{ m}^3$ ), *Rolan* ( $0.08 \text{ m}^3$ ) and Jonkheer van Tets ( $0.18 \text{ m}^3$ ) red currant cultivars and the *Carmela* ( $2.8 \text{ m}^3$ ), *Viorica* ( $2.6 \text{ m}^3$ ), *Bucovina* ( $3.2 \text{ m}^3$ ), *Ilinca* ( $3.8 \text{ m}^3$ ) and *Dacia* ( $2.3 \text{ m}^3$ ) apricot cultivars.

### ● Planting distances, nutrition area and density within an area unit of the studied shrubs and fruit trees.

The ground prints of the two diameters used to calculate the plants' volumes are also useful in determining the optimal planting distances. Planting distances take into consideration the

“care for Earth”, especially in urban agriculture where the plots of land are small anyway. These distances are 0.8 m x 0.8 m for the red currant cultivars, meaning a nutrition area of about 0.64 m<sup>2</sup> for each plant and a density of 15,625 plants/ha, or for smaller surfaces: 1,536 plants/1000 m<sup>2</sup>, 156 plants/100 m<sup>2</sup>, 16 plants/10 m<sup>2</sup>. For the V<sub>2</sub> goji biotype, the planting distance is 2 x 2 m, meaning 4 m<sup>2</sup> of nutritional area and plant density is 2,500 plants/ha, 250 plants/100 m<sup>2</sup>, 25 plants/10 m<sup>2</sup>. Regarding the apricot, 4 x 3.5 m planting distances are indicated for varieties with low vigour, meaning a 14 m<sup>2</sup> nutrition area and a density of 714 plants/ha, 71 plants/1000 m<sup>2</sup> and 7 plants/10 m<sup>2</sup>. Apricot varieties with average vigour have a recommended planting distance of 4 x 4 m, where each plant has a nutrition area of 16 m<sup>2</sup> and the plant density is 625 plants/ha, 63 plants/1000 m<sup>2</sup> and 6 plants/10 m<sup>2</sup> (Figure 1).



Figure 1. Apricot orchard with fallow band

#### • Technological sequences applied with a minimum energy input

The applied technological sequences model with minimum energy inputs and good results for the comparative study between biotypes and varieties of the black and redcurrant, apricot and goji species, refers to: the maintenance of allowed and mowed strips between the rows of shrubs and trees; mulching the rows with grass resulted from mowing; not applying phytosanitary treatments for the currants and goji shrubs and employing physical and mechanical plant protection measures while using an integrated system of treatments in the key stages of the apricot varieties' development, namely the: winter rest, budding, floral button, falling of petals, 2 cm in diameter fruit, post-harvest and falling of leaves phases; recycling the leaves, bunches, shoots and thin branches

through composting and fertilizing plants with the resulting compost.

#### • Fruiting precocity and yield levels of the studied cultivars and biotypes

Our research has revealed that the varieties and biotypes that have been studied carry the ability, within their genetic baggage, to enter the fruiting phase early, namely, for currant species in the second year, for goji in the first year and for apricot in the third year after planting; economic yields are obtained starting with the third year for currant species, with the second year for goji biotypes and with the fourth year for the apricot cultivars. Production levels reach a maximum during the balanced period situated between the growth and development and biological maturity cycles, and decrease during the aging stage, which sets in after the tenth year for the currant and goji species and after fifteen years for the apricot varieties. The *Ribes rubrum* L. cultivars that displayed notable yields were: *Elite* (194.38 g/plant and 863.91 kg/ha), *Rolan* (164.18 g/plant and 733.24 kg/ha) and *Jonkheer van Tets* (140.36 g/plant and 623.82 kg/ha). Within the *Ribes nigrum* L. species, the following varieties stood out: *Deea* (403.64 g/plant and 1,793.95 kg/ha), *Roxia* (268.29 g/plant and 1,192.40 kg/ha), *Elita 124* (228.69 g/plant and 1,016.25 kg/ha) (Table 1). The average yield per plant and per hectare for biotype V<sub>1</sub> of the *Lycium barbarum* L. species was slightly higher than that of biotype V<sub>2</sub>, namely 88.33 g/plant in the first year after planting, increasing to 545.49 g/plant in the third year of planting (Table 2). For the apricot species, fruit yields mainly vary according to cultivar, biotic and abiotic factors as well as negative temperatures that may occur after the flowering buds have broken dormancy or during flowering, fruiting and fruit development phases. During the biological maturity stage, the average yield for the studied cultivars was 10-13 t/ha, yet in years with climatic accidents such as 2004 or 2010, production only reached 2-3 t/ha. Slightly higher yields have *Viorica* and *Carmela* cultivars, belonging to the early varieties category (June 20 - 25), for the *Dacia* cultivar, belonging to the semi-early varieties category (June 28-July 5) and for the *Bucovina* and *Ilinca* cultivars which followed closely (Table 3).

Table 1. Average yield of the *Ribes rubrum* L. and *Ribes nigrum* L. cultivars, in the third year from planting

| Species and cultivars       | <i>Ribes rubrum</i> L. |        |         |              | <i>Ribes nigrum</i> L. |           |        |        |        |
|-----------------------------|------------------------|--------|---------|--------------|------------------------|-----------|--------|--------|--------|
|                             | Elite                  | Rolan  | Tatran, | Jh. van Tets | Deea                   | Elite 124 | Roxia  | Abanos | Tinker |
| Average yield per plant (g) | 194.4                  | 164.2  | 104.4   | 140.4        | 403.7                  | 228.7     | 268.7  | 175.2  | 147.3  |
| Average yield / ha (kg)     | 3037.5                 | 2565.6 | 1831.3  | 2193.8       | 6307.8                 | 3573.4    | 4198.4 | 2737.5 | 2301.6 |

Table 2. Average yield of the *Lycium barbarum* L. biotypes, in the first years from planting

| Biotypes       | Average yield/plant (g) |                 |                  | Average yield/ha (kg) |                 |                  |
|----------------|-------------------------|-----------------|------------------|-----------------------|-----------------|------------------|
|                | 2011<br>Year I          | 2012<br>Year II | 2013<br>Year III | 2011<br>Year I        | 2012<br>Year II | 2013<br>Year III |
| V <sub>1</sub> | 88.3                    | 355.7           | 545.5            | 84.8                  | 890.4           | 1318.7           |
| V <sub>2</sub> | 2.7                     | 50.8            | 81.4             | 6.7                   | 126.9           | 222.9            |

Table 3. Average yield of the *Prunus armeniaca* L. cultivars, during the balanced growing and development phase of the plants

| Cultivar                 | Rareş | Valeria | Carmela | Viorica | Dacia | Bucovina | Ilinca |
|--------------------------|-------|---------|---------|---------|-------|----------|--------|
| Average yield/plant (kg) | 16.7  | 16.8    | 21.1    | 22.6    | 21.3  | 22.5     | 16.0   |
| Average yield/ha (t)     | 10.44 | 10.54   | 13.19   | 14.16   | 13.34 | 14.09    | 10.06  |

• **Resistance to pests and pathogens of the *Ribes rubrum* L., *Ribes nigrum* L. and *Prunus armeniaca* L. cultivars, and of the *Lycium barbarum* L. biotypes as a key step in applying the low inputs technological sequences**

The pathogenic agent that attacked the red and black currant bushes was currant leaf rust: *Cromatium ribicola* – Fischer d.w. However, all varieties had an economic damage threshold (EDT) of up to 3-5%, which is an important criterion which recommends them for organic culture practices.

In the biocenosis where the goji biotypes were planted, the presence of harmful and useful entomofauna was observed by collecting it with the help of yellow sticky traps (Atraceras type) which were installed in the shrubs' crowns (Figure 2). The biological material was identified in the laboratory and sorted by taxonomic groups (PhD. Constantina Chireceanu, 2013 - Research and Development Institute for Plant Protection, Bucharest). The identified pests were not specifically targeting the goji culture, as they were mostly polyphagous species directly linked with the flora species from the immediate vicinity of the *Lycium* shrubs, rather than with this species itself.

What is important is that a wide range of taxonomic entomophagous groups was found, the highest frequencies being observed for the:

parasites belonging to the Hymenoptera order (the upper - families of: *Calcidoidea*, *Ichneumonoidea*, *Formicoidea*), followed by those in the *Coleoptera* order (*Coccinelidae* and *Staphylidae* families), the *Neuroptera* order (*Crysopidae* and *Hemerobidae* families) and the bugs belonging to the *Hemiptera* order (*Anthocoridae*, *Nabidae* and *Miridae* families).

Figure 2. Sticky trap placed within the crown of a *Lycium barbarum* L. shrub

The V<sub>2</sub> biotype showed no distinguishing mark pest or pathogen's attack, during the three years of study. The V<sub>1</sub> biotype was vulnerable to both powdery mildew, which was seen on the leaves of the shrubs with an attack rate of 54%, and to the *Aceria kuko* gall mite's attack, the degree of attack being 41%. The mite is specific to *Lycium* species and probably came with the biological material, although it was not observed at planting. However, it should be noted that neither fruit quantity nor quality were negatively affected.

Within the apricot plants' biocenosis, which was observed for more than seven years, none of the studied cultivars had a notable attack rate from the major pathogens which could cause great damage, such as *Monilinia laxa* (Aderh et Ruhl), *Stigmata carpophilla* (Lev) M. B. Ellis and *Cytospora cincta* Sacc. There were no reported signs of any virus attacks, especially that of the Plum-pox.

Pest monitoring and mainly that of the *Cydia molesta* fruit worm, achieved by installing pheromone traps, has revealed a damage rate of only 1% (PhD. Constantina Chireceanu). Within the entomophagous population, there was a greater density of *Forficula auricularia* L.

and *Cheliterea acantopigia* from the *Dermaptera* order and of *Adalia bipunctata* L., *Coccinella septempunctata* L., *Adonia variegata* (Goeze) and *Propylea 14 punctata* L. from the *Coccinelidae* order.

● **Biophysical, biochemical and health-promoting qualities of the fruit belonging to the *Ribes rubrum* L., *Ribes nigrum* L. and *Prunus armeniaca* L. cultivars and to the *Lycium barbarum* L. biotypes**

The size and weight of fruit, the content of dry substance, sugars, organic acids, phenols, flavonoids and also the antioxidant capacity were all basic criteria for the analysis of the currant and apricot cultivars and of the goji biotypes.

The goji biotypes, grown in Bucharest's area, have displayed levels of the fruit quality characteristics which confirm the data found in specialty literature. Although both biotypes are valuable in terms of biophysical, biochemical and health promoting characteristics, V<sub>2</sub> has higher levels of soluble dry substance (DM% = 17.3), ascorbic acid (59.9 mg/100 g), total sugars (58.9 mg/ml) and total polyphenols (200 mg galic acid/100 g) and also a higher antioxidant capacity (AR 45%) (Table 4).

Table 4. Quality characteristics of fruit at the "harvest maturity" ripening phase, for the *Lycium barbarum* L. biotypes

| Biotype        | Avg. fruit weight (g) | DM%  | Ascorbic acid mg/100g | Total sugars mg/ml | Total polyphenols mg galic acid /100 g | Antioxidant capacity(AR) % |
|----------------|-----------------------|------|-----------------------|--------------------|----------------------------------------|----------------------------|
| V <sub>1</sub> | 0.35                  | 15.9 | 31.6                  | 32.5               | 100                                    | 30                         |
| V <sub>2</sub> | 0.40                  | 17.3 | 59.9                  | 58.9               | 200                                    | 45                         |

Within *Ribes rubrum* L. species, the *Tatran* variety came out first considering the fruit size (3.27 g), high levels of flavonoids (1.12 mM rutin/ml), of polyphenols (5.77 mM GAB/ml), of sucrose (23.94%), the rate of antiradical activity (88%) and consequently the antioxidant capacity. High levels of polyphenols and antiradical activity are also present in the *Elite* and *Jh. van Tets* varieties (Table 5). The cultivars belonging to the *Ribes nigrum* L. species have larger fruit and higher values of biochemical and health-promoting characteristics, compared to the *Ribes rubrum* L. varieties. Fruit weight varied between 4.27 g (Abanos) and 5.91 g (Tinker); dry substance matter (DM%) varied between 14.66 (Tinker) and 17.36 (Abanos); polyphenols varied

between 7.06 mM GAB/ml (Roxia) and 8.06 mM GAB/ml (Elite); flavonoids varied from 0.93 mM rutin/ml to 1.37 mM rutin/ml and the antiradical activity varied from 64.2% (Elite 124) to 63.2% (Deea) (Figures 3 and 4).

The fruit quality of the *Prunus armeniaca* L. varieties was assessed based on their ripening stage. The largest fruit were those of *Viorica* (93.6 g), *Carmela* (89.6 g) and *Ilinca* (80.6 g) varieties. The levels of the fruit's biophysical and biochemical characteristics were high for all varieties of apricot. The DM% ranged from 15.4 to 21.3%, ascorbic acid was between 13.8 and 21 mg/100 g, malic acid varied between 1.14 and 1.83 g% and the fruit's stone ratio ranged from 3.5 to 4.2% (Table 6).

Table 5. Fruit quality characteristics of the *Ribes rubrum* L. and *Ribes nigrum* L. cultivars

| Species and cultivar         | <i>Ribes rubrum</i> L. |       |        |            | <i>Ribes nigrum</i> L. |           |       |        |        |
|------------------------------|------------------------|-------|--------|------------|------------------------|-----------|-------|--------|--------|
|                              | Elite                  | Rolan | Tatran | Jh.vanTets | Deea                   | Elita 124 | Roxia | Abanos | Tinker |
| Avg. fruit weight (g)        | 2.65                   | 2.42  | 3.27   | 2.86       | 5.30                   | 5.23      | 5.38  | 4.27   | 5.91   |
| DM%                          | 10.8                   | 12.9  | 10.4   | 11.5       | 15.1                   | 16.3      | 14.9  | 17.36  | 14.66  |
| Flavonoids mMrutin/ml        | 0.76                   | 0.33  | 1.12   | 0.92       | 1.37                   | 1.02      | 1.24  | 1.11   | 0.93   |
| Total polyphenols mM GAB/ml. | 4.44                   | 1.99  | 5.77   | 3.70       | 8.06                   | 6.66      | 7.06  | 4.33   | 6.21   |
| Antiradica lactivity %       | 71.13                  | 29.33 | 88.28  | 48.32      | 83.7                   | 64.2      | 83.02 | 76.25  | 72.2   |
| Sugars %                     | 28.6                   | 19.5  | 23.94  | -          | 12.86                  | 26        | 1.19  | 12.57  | 24.16  |

Figure 3. Elite variety (*Ribes rubrum* L.)Figure 4. Thinker variety (*Ribes nigrum* L.)Table 6. Fruit quality characteristics of the *Prunus armeniaca* L. cultivars (3 year average)

| Cultivar               | Rareș | Valeria | Carmela | Viorica | Dacia | Bucovina | Ilinca |
|------------------------|-------|---------|---------|---------|-------|----------|--------|
| Avg. fruit weight (g)  | 56.3  | 60.7    | 89.6    | 93.6    | 78    | 78.6     | 80.6   |
| Stone ratio (%)        | 3.5   | 3.6     | 4.0     | 4.1     | 3.7   | 4.2      | 4      |
| DM%                    | 17.2  | 15.4    | 20.4    | 21.3    | 18.4  | 18.2     | 18.2   |
| Ascorbic acid mg/100 g | 16    | 14.2    | 21      | 16.6    | 18.3  | 17.2     | 13.8   |
| Malic acid g%          | 1.25  | 1.25    | 1.43    | 1.39    | 1.14  | 1.42     | 1.83   |

● **The fruiting stages of the *Ribes rubrum* L., *Ribes nigrum* L., *Lycium barbarum* L. and *Prunus armeniaca* L. species**

This stage lasts very much for the goji biotypes, between 15<sup>th</sup> of June and 30<sup>th</sup> of November. For the apricot cultivars it is between 15<sup>th</sup> of June and 5<sup>th</sup> of August. For the red and black currant cultivars, this stage lasts from 10<sup>th</sup> to 30<sup>th</sup> of July.

## CONCLUSIONS

Based on the observed results it is recommended that varieties: *Deea*, *Elita* 124

and *Roxia* of the *Ribes nigrum* L. species (black currant), *Rolan*, *Jh. van Tets* of the *Ribes rubrum* L. species (red currant), the V<sub>2</sub> biotype of *Lycium barbarum* L. species (goji) and *Rares*, *Valeria*, *Carmela*, *Viorica*, *Bucovina*, *Ilinca* of the *Prunus armeniaca* L. species (apricot) should be cultivated in urban and periurban gardens.

The main qualities of the recommended varieties and biotypes refer to the: early fruiting, cost-effective out put produced in an environmental friendly, low or medium volume of shrubs and trees, plant density per area unit, high rates of gametes self-compatibility and the

organoleptic, biochemical and health-promoting fruit characteristics.

Among the biochemical and health promoting characteristics, there were high levels of: dry substance (15% - currants, 17% - goji and 22% - apricot), vitamin C (e.g. 24 mg/100 g - apricots, 60 mg/100 g - goji), flavonoids (e.g. 1.12 mMrutin/ml - currants), polyphenols (e.g. 200 mg. galic acid/100 g - goji) and antioxidant capacity (48 RA % in goji).

The presence of entomophagous species, their diversity, abundance and conservation, as well as the presence of useful fauna, especially birds, in the studied biocenosis of the currant, apricot and goji species, were promoted by the integrated management practices which left the trophic relationships unaltered within the agro-ecosystems where these plant species now belong.

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