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Overview of the scientific results in the field of shrubs crops in the Republic of Moldova

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ABSTRACT

The paper presents the results analysis of evolution stages on Fruit Growing Institution created in 1910 and of the scientific research carried out, as well as the contribution of scientists in the development of shrub species cultivation within Scientific Research Institute of Fruit Growing, Viticulture and Winemaking in Moldova during the 1946 to present, which were involved more than 70% of women researchers. The period of 2011-2019, compared with the period of 1974-1989 the average of strawberry harvest increased by 67.98% and average weight of berry by 60.84%. The average of blackcurrant harvest increased by 53.73%, the berry weight - by 20.0%. The average raspberry harvest increased by 78.31%, the berry weight by 4.17%. The average of gooseberry harvest increased by 85.4%, while the average of berry weight decreased by 19.4%.

Keywords: agricultural sciences, shrub species, cultivars, productions, Republic of Moldova.

INTRODUCTION

Fruit bushes are small plants, that are distinguished by early fruiting, easy reproduction, high and regular productions, relatively safe adaptation to development conditions, and cultivation technology. They are the first to open the supply season with dietary produce, which has unlimited demand among the population. The high yield, and ecological plasticity, selected by mechanization cultivation technologies, create advantageous conditions from an economic point of view for the cultivation of shrub species both in large industrial plantations and on small producers (Cazacov, 2009).The cultivars of fruit bushes, although they are propagated vegetative and have a relatively stable heredity, still show a certain degree of ecological plasticity, they can adapt to some extent to environmental conditions somewhat different from those for which they were created. The further these conditions are from those needed by the cultivar, the less satisfactory the results will be. The cultivation area must be chosen according to the cultivar's requirements, the same cultivar can give very good results in some regions, and poor in others (Cepoiu *et al*., 1996).

The favorable natural conditions, the centuries-old traditions of cultivating strawberries and fruit bushes, the economic and social importance, and the export of fruits and products derived from them have defined fruit growing as one of the main branches of agriculture in the Republic of Moldova (Sava, 2012). Cultivars of shrub species, in addition must meet the requirements of the market in terms of quality, must also be productive, having different cultural technologies compared to fruit trees. Shrub culture, although it

requires considerable investment, brings substantial incomes (Sava, 2016), already from the first years after the investment.

The scientific-practical research carried out by scientists throughout the development period of shrub crops, as well as today, allowed the creation of cultivars with different qualities and destinations, cultivation techniques, and technologies, based on which these precious crops became profitable, being extremely demanded by consumers due to its qualities.

MATERIAL AND METHOD

The study includes the analysis of the stages of evolution since the creation of the Fruit Growing Research Institute in 1910, of the Scientific-Practical Research carried out and the contribution of scientists in the development of fruit growing, especially in the direction of fruit-bearing shrubs within the Institute of Scientific Research in Fruit Growing, Viticulture and Winemaking in Moldova during the years 1946 to the present. The results obtained as a result of the scientific research carried out during the development of the field of cultivation of shrub species during the years 1946-1989 by the scientists from the Selection and Improvement of fruit and shrub crops section, and the Fruit Shrubs group from the Nursery section were analyzed comparatively over 700 cultivars of 4 shrub species: strawberry, raspberry, currant, gooseberry (Dushutina, 1946-1964; Maciucova, 1958-1974; Policarpova, 1958-1989). Starting from 1984 to present in the Small Fruits Laboratory on scientific and practical research has been carried out, the study of over 150 cultivars of 14 species of shrubs (strawberry, raspberry, black currant, red currant, white currant, josta, aronia, blackberry, gooseberry, seabuckthorn, blueberry, rose hip, chokeberry, viburnum, honeysuckle), (Sava, 1982-2023; Caterenciuc, 2011-2023; Rusnac, 2011-2023; Gherasimova, 2013-2022) have led to the developing of cultivation technologies.

RESULTS AND DISCUSSION

Horticultural research in Moldova began with the creation of the Plantation, Viticulture and Winemaking Station in 1910 on the territory of the Costiujeni estate, Chisinau district (fig. 1), which, starting in 1906, had a well-thought-out period of preparation and restructuring for the creation of the demonstration field experimentally (fig. 1).

As a result of various agrarian reforms, the Institution created for horticultural research and implementation, later evolved, operating under different names and forms, but which in fact was the basic pillar in the development of horticulture for the Republic of Moldova.

In addition to the Research Institution developed during the Soviet period, there was an experimental field for the implementation of the results of scientific research obtained in fruit growing and viticulture. It also owned a wine factory, where winemaking research was carried out, a section for experimenting with fruit preservation and processing methods, as well as a professional school for rapid training and qualification of fruit and viticulture workers.

The development of agriculture in step with technological progress and the continuous growth of the market's requirements for quality agricultural production imposed the approach of the problem from a scientific point of view. The promotion and spread of the precious shrub species, economically profitable for producers and highly demanded by consumers, due to its phyto-therapeutic properties.

The research carried out to study and appreciate the native assortment, as well as the new performing cultivars introduced from abroad, which did not always adapt to the soil and climate conditions in our country, which were different from those for which they were

created, oriented the horticultural research towards the creation of new local cultivars of strawberry and fruit bushes. These new cultivars had to combine qualities and destinations, cultivation techniques and technologies, which would be the most favorable for the conditions of our country.

In 1946, a collection was established for the study of 40 strawberry cultivars brought from different regions abroad of our country. In the study carried out by Dushutina (1961), the cultivars 'Moldovanca' (local cultivar) and 'Comsomolca' (cultivar created at the experimental fruit growing station in Moscow) were highlighted. These strawberry cultivars were among the most widespread cultivars in that period (50s-60s), and the 'Moldovanca' cultivar occupied over 50% of cultivated areas in Moldova (Condratiev, 1962).

As part of the research carried out on the improvement of cultivars of shrub species during the period 1956-1962, the 5 strawberry cultivars were created and described by Dushutina (1962): Mergeli (fig. 1 a), 'Frumushica', 'Orighinalinaia', 'Kishiniovscaia' and the native vcultivar 'Moldovanca' was selected. A clone of a western European raspberry cultivar of unknown origin was also selected, which acclimatized to the conditions of Moldova and was called Kishiniovscaia (tabl.1) shown in fig. 1 b (Duşutina, 1962; 1966).

a b

Fig.1. Cultivars of shrub crops created at the Institute: a) photo of the appearance of the strawberry 'Mergeli' *cv.;* b) photo of the raspberry 'Kishiniovscaia' *cv.*

Table 1. Strawberry and raspberry cultivars created in Moldova

Species and cultivar	Author name, year of creation	Year and publication
Strawberry: Moldovanca-local clone	Duşutina, K.K., 1946	Duşutina, K.K. Novie dlia Moldavii sorta iagodnih culitur. Chişinău, 1962, 12 p.
Strawberry: Mergeli(Moldovannca x Misovca)	Duşutina, K.K., 1953	Duşutina, K.K (1962). Author certificate nr.307 din 06.12.1965
Strawberry: Frumushica (Moldovannca x Poydniaia iz Zagoria)	Duşutina, K.K., 1953	Duşutina, K.K (1962). Author certificate nr.257 din 09.11.1965
Strawberry: Orighinalinaia (Moldovannca x Crasavitsa Zagoria)	Duşutina, K.K., 1953	Duşutina, K.K (1962). Author certificate nr.306 din 06.12.1965
Strawberry: Kishiniovscaia (Moldovannca x Crasavitsa Zagoria)	Duşutina, K.K., 1953	Duşutina, K.K. Novie dlia Moldavii sorta iagodnih culitur. Chişinău, 1962, 12 p.
Raspberry : Kishiniovscaia – local clone	Duşutina, K.K., 1958	Duşutina, K.K. Novie dlia Moldavii sorta iagodnih culitur. Chişinău, 1962, 12 p.

At the same time, they were studied and appreciated over 300 cultivars of strawberry and raspberry (Dushutina, 1961, 1962, 1966), over 200 cultivars of raspberry, currant, gooseberry (Masiucova, 1967); over 200 cultivars of strawberry, raspberry, currant, gooseberry (Policarpova, 1989); over 180 cultivars of shrub species (Parascovia Sava, 2003, 2012, 2015, 2016, 2019, 2021; Sava, Gherasimova, 2020; Rusnac and Sava, 2020; Caterenciuc and Sava, 2020; Sava and Caraman, 2022), the results of which had an important contribution to the development of this sector. The number of types of shrub species studied by our scientists in the framework of the research carried out during the development periods of the institute to identify the adaptable and productive ones for the new cultivation conditions were shown in fig. 2.

According to the data included in fig. 2 during the years 1958-1964, the most cultivars of shrub crops were studied (250 cultivars), and the fewest during the years 1964-1974 (63 cultivars).

As a result of the analysis of the research carried out for 76 years, it was established that this period was divided into two parts of 38 years each (fig. 3): the period up to the creation of the laboratory in the years 1946-1984 and the period within the laboratory in the years 1985-2022.

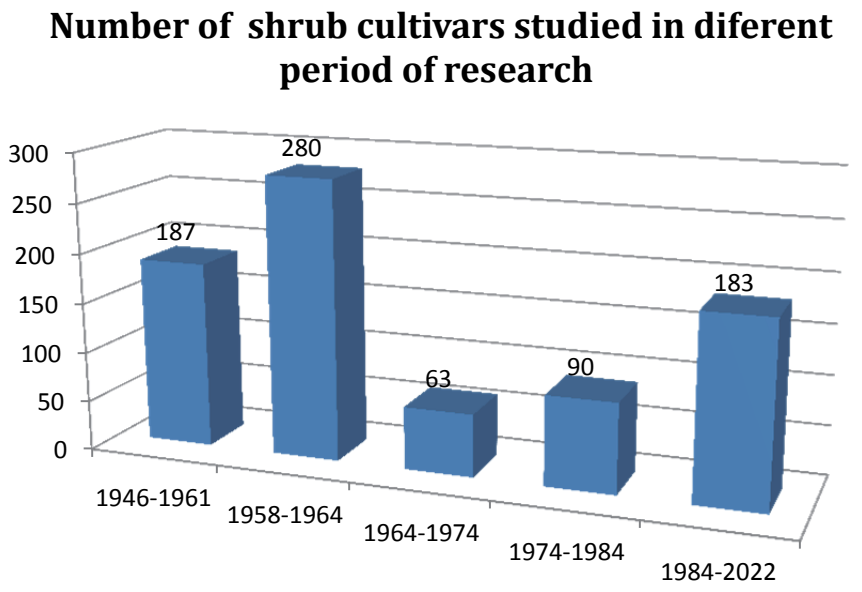

Figure 2. The number of shrub cultivar studied by the scientists on the Institute during the research
period 1946-2022.

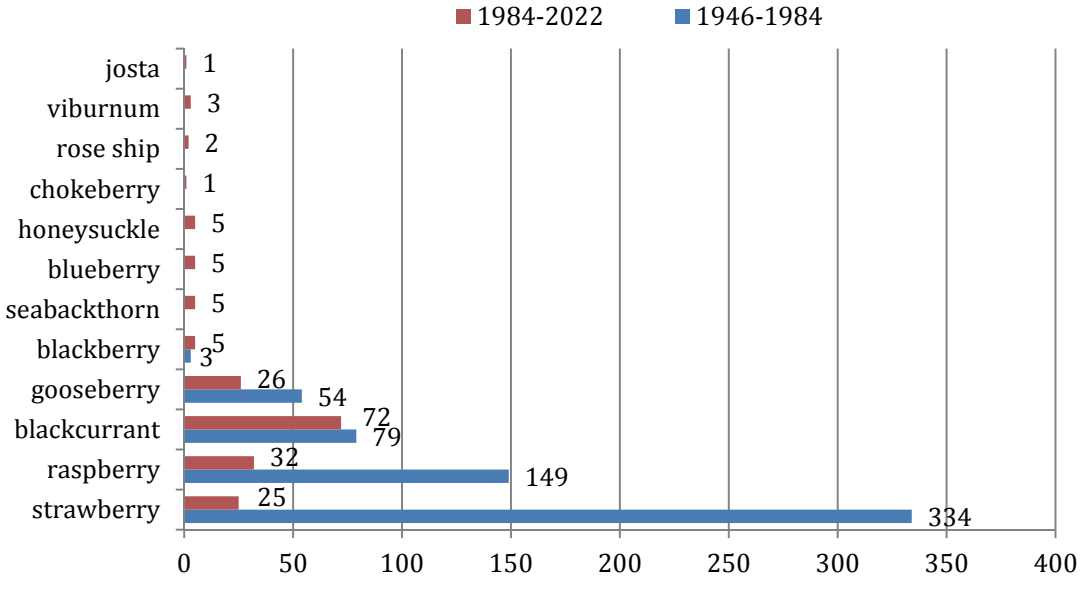

Figure 3. Species and cultivars of strawberry and fruit bushes studied in different periods of research for 38 years by the scientists of the Institute.

In the first period (years 1946-1984), 616 cultivars were studied in 4 species of shrub crops such as: strawberry, black currant, raspberry and gooseberry. In the second period (years 1985-2022); 183 cultivars were studied in 14 species of shrub crops such as: strawberry, raspberry, black currant, red currant, white currant, gooseberry, blackberry, seabuckthorn, blueberry, chokeberry, rose ship, viburnum, honeysuckle and josta. Within

the Fruit Shrubs group in the Fruit Nursery section, during the years 1974-1989, research was carried out by Policarpova (2015) on the following species: strawberry, blackcurrant, raspberry and gooseberry. The most widespread and cultivated shrub species in that period were strawberry and raspberry. In strawberry culture, 5 cultivars were distributed, 'Melitopoliscaia aromatnaia', 'Kuliver', 'Festivalinaia', 'Talisman', 'Senga Sengana' and 8 perspective cultivars: 'Pakahontas', 'Lvovscaia raniaia', 'Gorella', 'Kembrige Favorit', 'Red Gauntlet', 'Ada', 'Neiscerpaemaia', 'Sahalinscaia'. The *raspberry* culture in the catalog was present with two district cultivars: Latham, Fenix. At the same time, 10 perspective cultivars were included: 'Malling promiss', 'Malling juwel', 'Barnaulscaia', 'Novokitaevscaia', 'Taganka', 'Babie leto', 'Maroseica', 'Sputnitsa', 'Balzam', 'Scromnitsa', 'Brigantina'.

The *blackcurrant* was included in the Catalog with 5 district cultivars: 'Raniaia desertnaia', 'Golubca', 'Cercaşceanka', 'Altaiscaia desertnaia', 'Iunkor' and with 11 perspective cultivars: 'Seianets golubki', 'Ciornoglazaia', 'Minai Şhmariov', 'Beloruscaia sladcaia', 'Dicovinca', 'Liubimitsa Altaia', 'Pamiati Jucicovu', 'Izmailovskaia', 'Pushistaia', 'Krasa Altaia'. The assortment of *red currants* was not determined, but the cultivars: 'Ścedraia', 'Ciulcovscaia', 'Red cross', 'Holland red', 'Varshevicea' and of *white currants*: 'White Versailles', 'Smolianinovscaia' presented interest. The gooseberry assortment was not established, because it was cultivated only on small areas, in private households. Thus, in gooseberry culture, the following cultivars were of interest: 'Angliischii zelionai', 'Moscovschii crasnai', 'Capitan', 'Coloboc', 'Angliiskii joltai', 'Smena', 'Ruskii', 'Finic', 'Orlionoc', 'Iubileinâi', 'Malahit'.

The research carried out and the experience accumulated during the years 1982-2022 within the Fruit Shrubs group of the Fruit Tree Nursery section and the Fruit Shrubs and Strawberry laboratory within the research institute allowed the doctoral theses to be defended in 2003 on the topic: "Gooseberry productivity in depending on the cultivar and planting distance" and a qualified doctor in agricultural sciences in 2019 on the topic. Increasing the gooseberry and raspberry productivity in intensive culture by selecting cultivars and improving the structure of plantations (Sava, 2003; 2019).

Scientific research related to the creation of new cultivars of strawberry and fruit bushes better performing than the existing ones, with large, qualitative fruits and increased harvests, has essentially evolved from one stage to another. In the past, breeders and producers were satisfied with the average fruit mass of strawberry 10-20 g, raspberry, blackberry, gooseberry 2.0 g. Nowadays it has become possible to obtain cultivars with the mass of strawberry fruit 40-50 g, raspberry, blackberry, gooseberry of 5-6-8 g, and the cultivars with the biggest fruits even reach 12-15 g (Masiucova, 1967).

The mass of the berries is an important indicator of the value of the cultivar and the commercial aspect of the crop. However, the mass of berries in one and the same cultivar is not constant and varies depending on the growing conditions, the amount of the harvest, the place of cultivation, weather conditions, etc. It was established that among the studied strawberry cultivars with very large berries (average mass over 12 g) were: 'Alba', 'Vaybrant', 'Cupid', 'Mathis', 'Hanoiye', 'Elsanta', which significantly exceeded the standard 'Senga-Sengana' *cv.* with an average berry mass of 10.3 g (Novic, Clactscaia, 2021).

The analysis of the average mass of the fruits and the average harvest obtained in the cultivated cultivars of strawberry and fruit bushes during the years 1974-1989 is shown in figure 4.

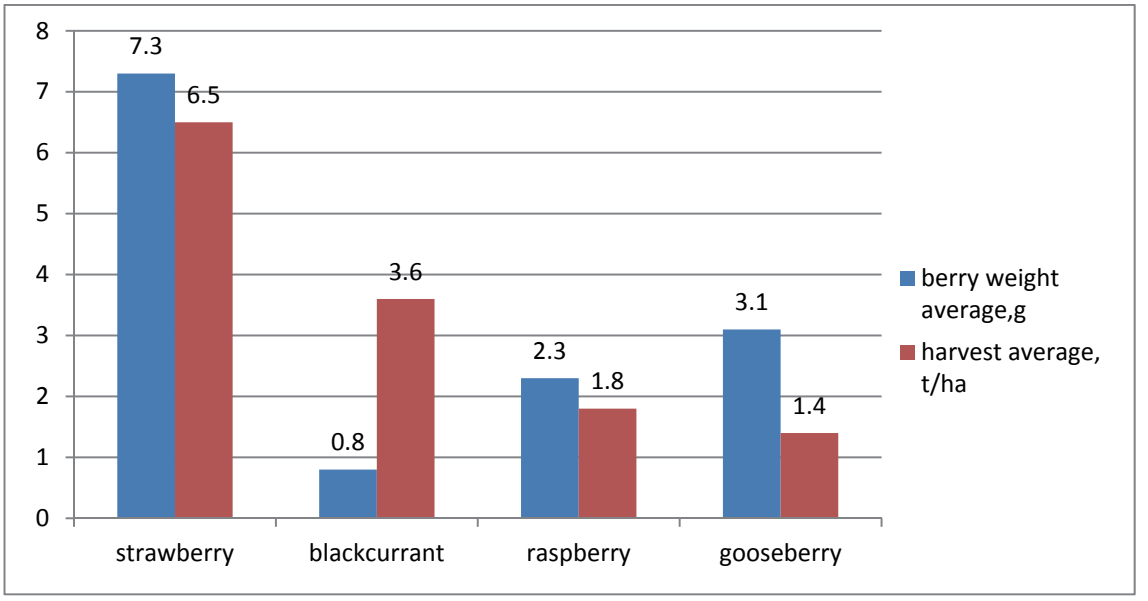

Figure 4. Berry weight average and harvest average of strawberry, blackcurrant, raspberry, gooseberry in the period of the years 1974-1989

According to the data included in fig. 4 among the shrub species studied, the highest fruit yield was obtained for strawberry, which reached 6.5 t/ha, and the lowest for gooseberry with 1.4 t/ha. The highest average mass of the fruits was obtained in strawberry reached 7.3 g, and the lowest in black currant - 0.8 g (Policarpova, 1989). The analysis of the average mass of the fruits and the average harvest obtained in the cultivated cultivars of strawberry and fruit bushes during the years 2011-2019 is presented in fig.5.

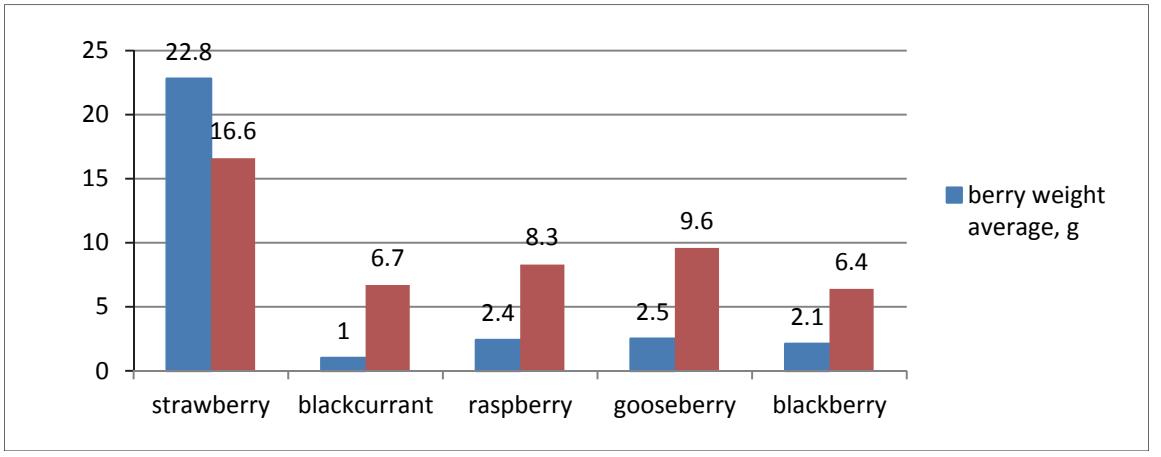

Figure 5. The berry weight average and the harvest average of strawberry, blackcurrant, raspberry, gooseberry, blackberry during years 2011-2019

According to the data included in fig. 5, the highest average yield is obtained for strawberry (22.8 t/ha), and the lowest for blackcurrant and blackberry (6.7 and 6.4 t/ha). The berries with the highest average mass were obtained from strawberry (16.6 g), and the lowest (1.0 g) from black currant (Sava, 2021).

In the studied periods of the years 1974-1989 and 2011-2019, the mass of fruits and the amount of harvest in strawberry, blackcurrant and raspberry evolved positively creating

cultivars with better and more productive qualities depending on the adaptation capacity of the cultivars and shrub species. At the same time, more diseases and pests developed and appeared, the climatic conditions became more changeable, negatively influencing the plants.

Analyzing the accumulated data on the studied cultivars of shrub crops in the periods of the years (1974-1989 and 2011-2019) we established that, compared to the first period, the strawberry fruit mass increased by 67.98%, and the harvest by 60.84%. The mass of currant fruits increased by 20.0%, and the harvest by 53.73%. The mass of raspberry fruits increased by 4.17%, and the harvest increased by 78.31%. While the mass of gooseberry fruits decreased by 19.4%, and the harvest increased by 85.4%, the cultivars becoming more productive, but with smaller fruits.

Between 2000 and 2015, the research were oriented towards the study in the central area of the Republic of Moldova on the phenological, biochemical, growth, development and fruiting indices of the cultivars introduced by: raspberry-20, gooseberry-29, mulberry-4, dogwood-3, sea buckthorn-5, blueberry-28 cultivars. The planting distances studied for raspberry are 2.5-3.0 x 0.5 m, for gooseberry and currant 2.5-1.5 x 0.75-1.0 m, for blackberry 2.5-3, 0 x 1.0-1.5 m, in heather, chokeberry, sea buckthorn 3-4 x 2-2.5 m, (Sava, 2016). As a result of the research, it was found that most of the shrubs species studied: raspberry (*Rubus Idaeus*), black currant (*Ribes nigrum*), red currant (*Ribes rubrum*) and white currant, gooseberry (*Ribes Grossularia* L.), Josta (*Ribes x nidigrolaria*), mulberry (*Rubus caesius* L.), white sea buckthorn (Hippophae rhamnoides L.), blue honeysuckle (Lonicera camciatscaia), blueberry (*Vaccinium corrymbossum* L.), dogwood (Viburnum opulus L.), chokeberry (*Aronia melanocarpa* Elliott), rosehip (Rosa rugosa Thnb) have an early vegetation start, which coincides with March, flowering - takes place in April, and ripening in June-July; The earliest species is the honeysuckle whose vegetation begins between 03.03-09.03, flowering takes place between 30.03-26.04, and its fruits are good to harvest already in the second half of May (19-25.05), before the ripening of the strawberry fruits; The raspberry has a later start of vegetation (09.-21.04), it blooms during May with the beginning of ripening in June. Everbearing raspberry cultivars start flowering in July and ripen in August; The blackberry has the latest start in vegetation (24.04-04.05), with the latest flowering, 18.05-04.06, a fact that allows the plants, and especially the flowers, to overcome the danger of being affected by the late spring frosts, and the ripening being staggered, with beginning in July lasts up to 30-40 days (Sava *et al.,* 2022). The productivity of the sea buckthorn cultivars ('Otradnaia', 'Botanicescaia', 'Trofimovscaia', 'Podaroc sadu') studied during the years 2015-2018 varied between 5.1-15.00 t/ha, and the weight of the fruits oscillated between 0.42-0.7 g. In 2017, the highest harvest was obtained with the 'Otradnaia' *cv.,* and the largest fruits with the 'Podaroc sadu' cultivar (Sava, and Gherasimova, 2020). As a result of the study of mulberry cultivars ('Darrow', 'Smoothstem', 'Thornfree') during the years 2015-2018, it was determined that their harvest varied between 3.4-6.7 t/ha, and the weight of the fruits oscillated between 3.0-5, 1 g In 2018, the highest harvest and the largest fruits were obtained for the 'Thornfree' genotype (Caterenciuc and Sava, 2020). The research carried out regarding the fruit production obtained depending on the species, allowed us to establish that the gooseberry harvest varied between 7.36-11.9 t/ha, at Josta between 4.7-8.2 t/ha, at black currant between 4.3-8.1 t/ha, red currant between 4.3-8.5 t/ha, and white currant between 3.7-7.8 t/ha. In the conditions of a favorable year, 2015, the highest harvests were obtained for black currant - 8.1 t/ha; in 2016 gooseberry - 11.8 t/ha, Josta - 8.2 t/ha, red currant - 8.5 t/ha, white currant - 8.2 t/ha. (Sava, Caraman, 2022). The research carried out during the years 2000-2010 on the summer bearing raspberry culture allowed us to establish that the most productive cultivars with an average harvest between 9.3–

10.3 t/ha are: The 'Latham', 'Rubin', 'Kirjaci, 'Delbard Magnific', and for the everbearing genotypes: 'Polana', 'Autumn Bliss' with a yield of 16.2-18.7 t/ha. The average weight of the fruits in summer bearing cultivars varied between 2.7-3.1 g, and on everbearing cultivars between 1.7-3.1 g. In raspberry plantations, which exceed the exploitation period of 8-9 years, the growth and development processes of the plants, the photosynthetic activity, the harvest and its quality are reduced, and as a result they are no longer efficient to be maintained (Sava, 2016).

CONCLUSIONS

The scientific research carried out at the Institute of Scientific Research in Fruit, Viticulture and Winemaking from Moldova under the conditions of the Republic of Moldova (currently IP IŞPHTA) during the years 1946-2022 by the predecessor scientists and the current researchers have contributed essentially to the development of the planting material production sector and strawberry fruits and fruit bushes through:
The creation and development of the fruit tree research base, of the shrub crops direction starting from the period of 1946 until now;

- The study of 616 cultivars (4 species) of strawberry, blackcurrant, raspberry and gooseberry to identify the most productive and qualitative ones during the period 1946-1984;
- Studying during the years 1985-2022 in the laboratory 183 genotypes of 14 species of strawberry and fruit bushes to identify the most productive and qualitative ones;
- Creation of new autochthonous cultivars of strawberry: 'Mergeli', 'Frumushica', 'Orighinalinaia', 'Kishiniovscaia', ' Moldovanca'; and raspberry - 'Kishiniovscaia';
- The improvement and implementation in production of the technologies for the cultivation of strawberries and fruit bushes in the traditional culture, as well as the ecological one;
- Appreciation of the degree of adaptability, the influence of climate changes, the maintenance conditions of the plants and the influence of the cultivar on productivity;
- Determination of the average fruit harvest during the years: 1974-1989 varied between 6.5 t/ha (strawberry) and 1.4 t/ha (gooseberry); 2011-2019 varied between 6.7 t/ha (blackcurrant) and 22.8 t/ha (strawberry);
- Determination of the average mass of fruits during the years: 1974-1989 varied between 0.8 g (blackcurrant) and 7.3 g (strawberry); 2011-2019 varied between 1.0 g (blackcurrant) and 16.6 g (strawberry);
- Elaboration for producers of recommendations for the application of methods and technological elements aimed at reducing the influence of various factors on shrub species.

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