Forest melliferous resources in the Republic of Moldova

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Abstract: Exploiting of forest melliferous resources is within the sphere of activity of various production and processing enterprises but also is a subject of increased attention of scientific, social and environmental organizations. The purpose of the research is to describe the forestry melliferous resource sector of the Republic of Moldova, identification of melliferous capacity of plants and influence of some factors on honey resources. The research objectives were: inventory of taxonomic composition of forest melliferous plants of the Republic of Moldova; analysis of the phenological spectrum of flowering of forest melliferous plants; identification of factors that influence honey resources; melliferous capacity of some forest plants; identification of the opportunities for the development of honey resources. The research methods were: studying of specialized scientific literature, analysis and synthesis, organizing and systematization of information, analogy and comparative data analysis. Taxonomic composition of the forest melliferous plants from the Republic of Moldova comprises 41 families, 129 genera and 224 species. After the flowering period forest melliferous flora consists of 136 spring species and 88 summer species. Spring plants belong to 32 botanical families dominated by *Fabaceae* (21 species) and *Scrophulariaceae* (18 species), *Lamiaceae* (16 species), *Rozaceae* (13 species). Summer plants belong to 20 botanical families dominated by *Fabaceae* (14 species), *Lamiaceae* (14 species), *Asteraceae* (12 species), *Scrophulariaceae* (11 species). According to biological cycle forest honey plants are presented in such a way: annual-13%; biennial-9% and perennial-78%. According to biological form forest melliferous plants are represented by trees-15%; shrubs-11% and herbaceous plants-74%. Most of the forestry plants of the Republic of Moldova have a medium beekeeping share (46%), 28% have a small apiculture share. Plants with a very high apiculture share account for 1% and high apiculture share have 5%. The current area of the forestry fund (421.7 thousand ha) can feed around 1000000 bee families.

Keywords: forest resources, melliferous plants, forest, pollen, honey-dew.

1. Introduction

The Forest is a precious alive treasure of Terra, an ecosystem that provides protection and some vital global conditions for humanity. Since the antiquity, the multifunctionality of the forest has been recognized in the natural and economic environment (Popescu, 2008).

The issue on evaluation of natural resources including the honey one began in the middle of 1960s of the last century. However, the approach of the economic evaluation of forest resources during the soviet period has narrow specific at branch level, only the wood being considered the main wealth. The honey products of the forest were not part of the country's wealth, their economic potential was not analyzed, as an additional source

of income to contribute to the development of the forestry sector.

Utilization of melliferous forest products is a concern in many countries of the world and depends on geographical area, specific flora, needs and habits.

Providing the country with natural honey resources is an important economic factor in national development. The structure of these resources, their value, quality, study degree and impact on economic potential.

A successful development of beekeeping is closely linked to the forest.

Life, evolution and development of bee families depend on the existence of melliferous plants and the way of production of pollen and nectar secretions (Pashcalau, 2009).

The specialty literature mention the fact that there are known more than 1000 species of melliferous plants, of which only 200-300 are important for bee feeding (Pârvu, 2000).

The level of development of beekeeping, productivity of bee families and the quality of honey directly depends on natural conditions, primarily with floral composition and then follows climatic, pedological and phenological factors (Burmistrov and Nikitina, 1990).

Honey resources are part of the natural and agricultural ecosystems. Their rational evaluation and use is a current and perspective theme.

Bee action solves a wide range of socio-economic issues, from increasing plant productivity up to securing population with unique apicultural products for health maintaining.

Development of beekeeping within the forestry fund contributes to the increase of the productivity of agricultural plants by 40% (sunflower, buckwheat), by 60% (pumpkin cultures), by 65% (fruit trees). According to the appreciation of the experts, annual additional income, obtained due to the pollination of crops by insects exceeds 8-10 times the direct income from the honey products (Samsonova, 2014).

Therefore, correct organization of beekeeping and complex use of melliferous resources bring considerable revenue and pollination by bees of agricultural crops increases production by 20-30%. Beekeeping is very productive if natural honey resources are used, agricultural crops as well as spontaneous flora, not just around the bee-garden but also within a reasonable distance. For the advantageous location of beehives, the optimal distance where the bee flies for nectar collection must also be taken into account, which is up to 2 km (Sidorova, Pashaian, Kalashnikova, 2014).

That's why beekeepers need to know and consider local conditions, regarding the distribution of honey resources.

Due to bee pollination by bees, the income is 20 times higher than that obtained from the sale of honey, propolis, beeswax (Tyshkevich, 1991).

The majority of flower plants are pollinated by pollinating insects. About 80% of superior plants are entomophiles, and 20% are pollinated by the wind (Jerukov et al, 2012).

For the Republic of Moldova forest as a natural melliferous resource is very important because it is renewable and allows sustainable use.

According to the Forestry Code of the Republic of Moldova, honey plants are included in the category of non-wood products of the forest (Forestry Code, 1996).

A complex approach to the use of forest products, in case of rising food shortages, especially in densely populated areas, non-timber forest products pass to the first place, and wood collecting to the second place (Hisamov and Kulagin, 2008).

Honey production depends on several factors: genetics of the bee, pedoclimatic conditions, composition of melliferous resources, phenology of flowering, beekeeper's knowledge and applied technology. An important differentiation of honey is made by botanical origin (acacia, linden) which also has some specific features and properties (smell, color, taste) (Malaiu, 1976).

Depending on environmental conditions honey resources of plants vary quantitatively and qualitatively.

Proskureakov M. (2007) states that productivity of nectar at plants is directly influenced by air temperature and humidity, degree of illumination, moisture and soil quality, age and density of plants (Proskureakov, 2007).

One of the decisive meteorological factors, which influence the production of nectar, is temperature and humidity. Generally the optimal temperature for nectar secretion is 25-30^{0}C. Atmospheric humidity of 40-80% has a positive influence on nectar secretion. Increase or decrease of these indices negatively influences the secretion and production of nectar (Bura, 2005).

At air humidity of 51%, linden flowers (*Tilia* sp.) contain about 70% of sugar, but at air humidity of 100% they contain only 22% of sugar. At air temperature of +18^{0}C…+21^{0}C nectar is produced in increased quantity (1.62 mg), at a higher temperature the amount of nectar decreases. All melliferous plants produce nectar in larger amounts on fertile soils, well-structured, sufficiently moist and rich in natural fertilizers. Most important for apiculture are the following species: *Tilia* sp., *Robinia pseudacacia* L., *Acer platanoides* L., *Salix* sp., *Malus sylverstris* L, *Aesculus hippocastanum* L., *Crataegus monogyna* Jacq. (Vorobieva, 2015).

It has been established that during the flowering period productivity of mature linden trees is about a ton of nectar per hectare. The difference of melliferous productivity at linden stands between the ages of 51 - 60 years is 1.3 times higher than in the stands of 41 - 50 years. Researches have shown that the optimal temperature when a maximum amount of nectar is eliminated is 26^{0}C. The temperature difference of 5^{0}C between day and night causes the maximum elimination of nectar, and less or higher temperature difference decreases the amount of nectar. Reducing of daytime temperature by one degree during the flowering period decreases the productivity of bee family by 1-2 kg of honey (Madebeikin and Shilov, 2013).

According to the data from the specialty literature, 1 ha of *Tilia* sp. with mature trees has melliferous productivity

of 500-1000 kg, depending on stationary conditions (Krivtsov and Burmistrov, 2004).

Locust tree (*Robinia pseudacacia* L.) has a very large melliferous potential. Productive average of one flower is 2.85 mg of nectar containing 56.5% of sugar. A young tree can produce 0.4 kg of honey. At the age of 12 years a locust tree has about 24.1 thousand/flowers, and at the age of 25 years 64.4 thousand/flowers. Depending on biotope conditions, one hectare of locust tree has a productivity of 50-1500 kg/honey/ha. The period of nectar collection lasts for about 19 days (Kurgina, 2012).

Locust tree is of particular importance because it insures the main spring picking. Honey production varies in dependence of how trees are planted: rarely planted trees produce 1100-1700 kg of honey/ha, trees from the massive 900-1500 kg/ha, and from the stands 300-700 kg/ha (Lazar, 2002).

Pozdeev D. investigated the influence of environmental factors on plant nectar, perfected the method of prognosis for melliferous plant productivity from forestry fund. Density decrease of the stand with *Tilia* sp. until the optimal degree rises the nectar quantity from 3.3% to 13.5%. Flowering is more abundant in mature and old stands with *Tilia* sp. Productivity average of honey at linden trees with small leaf *(Tilia cordata* Mill.) was 550 kg/ha; at willow (*Salix triandra* L.) male flowers 94 kg/ha, female flowers 129 kg/ha; at *Caragana arborescens* Lam. 58 kg/ha. The greatest influence of temperature on the productivity of nectar was at *Caragana arborescens* Lam. in a proportion of 97% and at *Salix triandra* of 84% (Pozdeev, 2004).

The researches Hisamov R. and Kulagin A. (2009) aimed at investigation of situation and perspective of using the melliferous resources from the forestry fund. The results of research demonstrated that there is a direct link between the number of bees, quantity of honey products and afforested area (r=0,58-0,69), and especially the area of honey plants (r=0,74-0,78) in linden stands. A closed link is established between the productivity of a bee family with mature and old trees of *Tilia* sp. (r=0,88), nominally this age category has an influence on the whole honey surface (r=0,77) (Hisamov and Kulagin, 2009).

Gluhov M. (2012) gives special attention to characterization of stationary conditions and to the methodology of melliferous products collection. There were described some methods of raising the productivity of the areas with melliferous resources, at approximately 200 honey plants. Major influences on the production of nectar by the plants have age, weather and day time, climate, soil, light etc. More nectar is produced by the plants in the first half of the day (in the morning), during warm and humid weather. The melliferous productivity of linden is the most sensitive to weather conditions. Plant areal, soil, rock and cultivation technology have less influence on the amount of produced nectar. The earliest melliferous resources are trees and coppice (April-May), followed by meadows (May-June) and plains (July-August) (Gluhov, 2012).

Due to bee pollination plants grown from these seeds have a higher germination energy and more intense development (Malkin and Buharkin, 2009).

At present, there are about 124330 bee families on the territory of the Republic of Moldova, with an average productivity of 33.6 kg/honey/family (Modvala, 2015).

Due to intensive exploitation of the afforested areas the number of spontaneous bees decreased.

There are clear evidences that intensification of agriculture has negative effect on apiculture. This trend is more visible in western countries, due to intensive use of pesticides and enlargement of cultivated areas, all of them contributing to reducing the biodiversity of honey plants (Decourtye, Mader, Desneux, 2010).

Due to the diversity of forest melliferous plants, a large amount of apicultural and pure ecological products can be provided.

2. Materials and methods

The purpose of the research is to describe the forestry melliferous resource sector from the Republic of Moldova, as well as identification of melliferous capacity of plants.

The research objectives were: inventory of the taxonomic composition of the forest melliferous plants from the Republic of Moldova; analysis of the phenological spectrum of flowering of forest melliferous plants; melliferous capacity of some forest plants; identifying opportunities for the development of honey resources.

Forest honey plants species from the Republic of Moldova had been inventoried using the specialty literature (Cîrnu, 1973, 1980; Gheideman, 1986; Nesterov, Pinchiuk, Leonteak, 1988; Cebotari, Gheideman, Nikolaeva, 1986; Chifu, Mânzu, Zamfirescu, 2006; Negru, 2007; Pînzaru, Sîrbu, 2016).

The research methods were: reading of specialized scientific literature, analysis and synthesis, organizing and systematizing of information, analogy, calculation and comparative analysis of data.

For better familiarization and systematization of melliferous plants, we used the following classifications (Cîrnu, 1980):

Phenological classification refers to the flowering period of the melliferous plants:

- Early spring melliferous plants (February-March);
- Spring melliferous plants (April-May);
- Summer melliferous plants (June-July);
- Autumn melliferous plants (August-September);
- Late autumn melliferous plants (October-November).

After the flowering phenophases, plants within the study were grouped in two periods: spring and summer.

Beekeeping classification is based on the nature of the feed source provided to bees and comprises 3 groups:

- Polliniferous plants group includes species from which bees collect only pollen;
- Nectariferous plant group includes species from which bees

usually collect nectar.

- Nectariferous-polliniferous plant group is the most important including melliferous species with the largest economic and beekeeping ratio. Melliferous plants from this group are the most numerous and provide bees with pollen and nectar.

Depending on the quantity of the eliminated nectar during the flowering period, melliferous plants from the Republic of Moldova have been divided into five groups (Nesterov, Pinchiuk, Leontyak, 1988):

- Plants with high nectar potential (abundantly secret nectar and occupies large areas);
- Plants with good nectar potential (abundantly secret nectar in local areas);
- Plants with medium nectar potential (annually secrete nectar and contribute to the formation of minor honey reserves);
- Plants with weak nectar potential (secrete inessential amount of nectar and don't contribute to the formation of honey reserves);
- Plants with non-significant nectar potential for beekeeping.

In order to determine melliferous productivity of plants per hectare, the following relationship is used (Nesterov, Pinchiuk, Leontyak, 1988):

$$X=a\times b\times c,$$

where: X – sugar productivity per hectare;

a – amount of sugar at a flower (mg);

b – number of flowers per hectare;

c – flowering period (days).

If plant's sucrose productivity of plants per hectare is known and 100% of honey consists of 80% of sugar and 20% of water, honey production per hectare is calculated according to the following formula:

$$Y=X\times 1.25$$

where: X – amount of sugar, kg/ha,
and 1,25 – the sugar convection factor in honey.

The production of sucrose per hectare of the main forest melliferous plants from the Republic of Moldova is 800 kg at white acacia (*Robinia pseudoacacia* L.), 400 kg at linden (*Tilia* sp.), 200 kg at *Acer* sp., 100 kg at *Salix* sp., 20 kg at shrubs, and 15 kg at meadow (Nesterov, Pinchiuk, Leontyak, 1988).

The number of bees' families that can be maintained on a particular surface is determined by using the following formula (Cîrnu, 1980):

$$F=\frac{M}{m}, \text{ where:}$$

M – represents 1/3 of total honey production;

m – quantity of honey necessary for a family of bees for one year which is approximately 130 kg.

3. Results

Forests of the Republic of Moldova constitute a part of the national natural heritage. They play a special role in maintaining of ecological balance, conservation of biodiversity, landscape protection, and food and energy security.

According to the National Bureau of Statistics of the Republic of Moldova, the current area of the forestry fund is 421.7 thousand hectare (http://statbank.statistica.md).

By their composition forests of the Republic of Moldova are divided into deciduous (97.8%) and coniferous (2.2%). Figure 1 shows the distribution of the forestry fund species (Andreev et al, 2017).

Among melliferous species with high beekeeping potential, acacia predominate (33.1%). Linden represents 1.5%, willow and poplar 3%. Other species (6.1%) which feed bees are the following: maple, field maple, cherry etc.

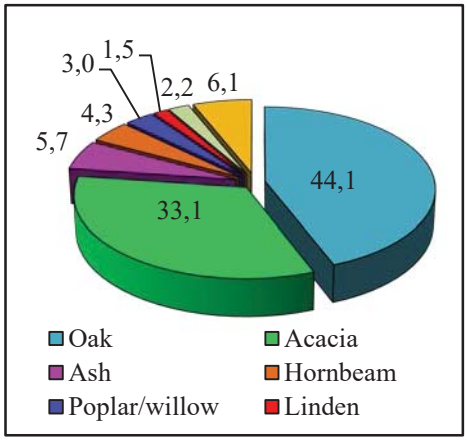

Fig. 1 Distribution of forestry fund species from the Republic of Moldova %

Honey plants offer nectar and pollen for bees. Due to the succession of flowering during the vegetation period, they provide a high maintenance pickup, for the development of bee families.

Deciduous forests consisting of trees and shrubs mixtures are the richest in melliferous vegetation. Bees have an almost uniform and long-lasting picking in this stands, which starts from spring and keeps until autumn.

In appreciating the forests from a melliferous point of view, we must take into account that, the forest offers a more abundant pick, the more varied is vegetation.

In case of establishing of taxonomic composition of species, flowering period, intensity, melliferous capacity, it can be developed a plan to highlight this natural resources.

Due to the favorable environmental conditions there is a rich and varied melliferous flora in our country.

For a superior exploitation melliferous resource it is necessary to know the main melliferous species.

Forest melliferous plant under inventory are: **trees** - *Acer campestre* L., *A. negundo* L.. *A. platanoides* L., *A. pseudoplatanus* L., *A. tataricum* L., *Aesculus hippocastanum* L., *Cerasus avium* L., *Fagus sylvatica* L., *Fraxinus excelsior* L., *F. ornus* L., *Gleditsia triacanthos* L., *Malus sylvestris* Mill, *Populus alba* L., *P. nigra* L., *P. tremula* L., *Prunus divaricata* Ledeb., *P. insitia* L., *Quercus petraea* Liebl., *Q. pubescens* Willd., *Q. robur* L., *Q. rubra* L., *Robinia pseudacacia* L., *Salix alba* L., *S.caprea* L., *S. fragilis* L., *Sorbus aucuparia* L., *S. domestica* L., *S. torminalis* L., *Styphnolobium japonicum* L., *Tilia cordata* Mill., *T. europaea* L., *T. tomentosa* Moench, *Ulmus campestris* L., *U. glabra* Huds., *U. laevis* Pall.; **shrubs** - *Amorpha fruticosa* L., *Amygdalus nana* L., *Caragana arborescens* Lam., *Cerasus fructicosa* Pall., *Chamaecytisus austriacus* L., *Clematis vitalba* L., *Cornus mas* L., *Corylus avellana* L., *Crataegus*

monogyna Jacq., *Daphne mezereum* L., *Frangula alnus* Mill., *Ligustrum vulgare* L., *Lonicera xylosteum* L., *Prunus divaricata* Ledeb., *Prunus spinosa* L., *Rhamnus catharica* L., *Rosa canina* L., *Rubus caesius* L., *R. idaeus* L., *Salix cinerea* L., *Sambucus nigra* L., *Spiraea hypericifolia* L., *Staphylea pinnata* L., *Swida sanguinea* L., *Viburnum opulus* L., *Teucrium chamaedys* L.; **herbaceous plants** - *Abutilon theophrasti* Medik., *Acinos arvensis* Lam., *Adonis vernalis* L., *Aegopodium podagraria* L., *Ajuga reptans* L., *Alium rotundum* L., *Althaea officinalis* L., *Anchusa italica* Retz., *A. officinalis* L., *A. procera* Bess., *Angelica arhangelica* L., *Anthiriscus cerefolium* L., *Arctium minus* Hill., *Aristolochia clematitis* L., *Astragalus glycyphyllos* L., *Ballota nigra* L., *Berteroa incana* L., *Campanula glomerata* L., *Carduus crispus* L., *Carduus hamulosus* Ehrh., *Carum carvi* L., *Cerinthe minor* L., *Chamaenerion angustifolium* Hill., *Cichorium intybus* L., *Cirsium oleraceum* L., *Clematis integrifolia* L., *Crepis biennis* L., *C. pannonica* (Jacq.) C. Koeh., *Coronilla varia* L., *Corydalis cava* L., *C. solida* L., *Descurainia sophia* L., *Digitalis lanata* Ehrh., *Dipsacus fullonum* L., *D. laciniatus* L., *D. pilosus* L., *D. strigosus* Willd ex Roem, *Echinops ritro* L., *E. sphaerocephalus* L., *Echium vulgare* L., *Epilobium hirsutum* L., *E. montanum* L., *Eryngium campestre* L., *E. planum* L., *Erysimum canescens* Roth., *Eupatorium cannabinum* L., *Ficaria verna* Huds., *Filipendula ulmaria* L., *F. vulgaris* Moench., *Fragaria moschata* Duch., *Gagea lutea* L., *Galanthus nivalis* L., *Galeopsis ladanum* L., *G. speciosa* Mill., *G. tetrahit* L.,*Geranium pratense* L., *G. sanguineum* L., *Glechoma hederacea* L., *Hypericum elegans* Steph., *Lamium album* L., *L. maculatum* L., *L. purpureum* L., *Lathyrus aureus* Stev., *L. niger* L., *L. nissolia* L., *L. pratensis* L., *L. tuberosus* L., *Lavatera thuringiaca* L., *Lembotropis nigricans* L., *Leonurus cardiaca* L., *L. quinquelobatus* Gilib., *Leontodon autumnalis* L., *Lilium martagon* L., *Lotus corniculatus* L., *Lycopus europaeus* L., *Lythrum salicaria* L., *Malva sylvestris* L., *Marrubium vulgare* L., *Medicago falcata* L., *M. lupulina* L., *M. romanica* Prod., *Melilotus albus* Medik., *Melissa officinalis* L., *Oenothera bienis* L., *Onobrychis arenaria* Kit., *O. vicifolia* Scop., *Ononis arvensis* L., *Onopordum acanthium* L., *Origanum vulgare* L., *Oxytropis pilosa* L., *Phlomis pungens* Willd., *P. tuberosa* L., *Pimpinella saxifraga* L., *Prunela grandiflora* L., *P. vulgaris* L., *Pulmonaria obscura* Dumort., *Pulsatilla grandis* Wend, *Ranunculus illyricus* L., *R. oxyspermus* Willd., *R. polyanthemos* L., *R. stevenii* Andrz., *Reseda lutea* L., *Salvia nemorosa* L., *S. pratensis* L., *S. verticillata* L., *Sambucus ebulus* L., *Sanguisorba officinalis* L., *Saponaria officinalis* L., *Scilla bifolia* L., *Scrophularia nodosa* L., *S. vernalis* L., *Sedum acre* L., *Silene nutans* L., *Solidago virgaurea* L., *Sonchus arvensis* L., *Stachys annua* L., *S. germanica* L., *S. officinalis* L., *S. palustris* L., *S. recta* L., *S. sylvatica* L., *Stellaria media* L., *Symphytum officinale* L., *Taraxacum officinale* Wigg, *Tragopogon orientalis* L., *Trifolium hybridum* L., *T. pratense* L., *T. repens* L., *Trigonella caerulea* L., *Tripolium vulgare* Nees, *Tussilago farfara* L., *Verbascum phlomoides* L., *V. phoeniceum* L., *V. nigrum* L., *Veronica agrestis* L., *V. arvensis* L., *V. austriaca*

L., *V. barrelieri* Schott, *V. chamaedrys* L., *V. hederifolia* L., *V. jacquinii* Baumg, *V. longifolia* L., *V. montana* L., *V. officinalis* L., *V. orhidea* L., *V. persica* Poir., *V. polita* Fries, *V. prostrata* L., *V. scutellata* L., *V. serpyllifolia* L., *V. spicata* L., *V. spuria* L., *V. tetrasperma* L., *V. teucrium* L., *V. triphylos* L., *V. verna* L., *V. villosa* Roth, *Vicia angustifolia* Reichard, *V. sepium* L., *V. cracca* L., *V. hirsute* L., *V. pannonica* Crantz, *V. sativa* L., *V. tenuifolia* Roth, *Vincetoxicum hirundinaria* Medik., *Viscaria vulgaris* Bernh.

Biological form of melliferous flora, determines the quantity and quality of honey, especially the trees of acacia and linden. Acacia and linden honey is the most demanded on the internal and external markets, and the trading price is also the highest.

There are about 6 thousand hectares of linden forest and about 140 thousand hectares with acacia in the national forestry fund of the Republic of Moldova. Linden occupies important areas in the central region of the Republic of Moldova, and acacia in the south region. Acacia forms pure stands, and linden comes into the composition of oak stands and sessile oak stands, practically lacking the pure stands.

Plants inhabit all living environments being under the influence of environmental factors. To survive plants have changed their structure and physiognomy.

Figure 2 shows the ratio of the species of melliferous plants according to the biological form. From the totality of inventoried species trees represent-15%, shrubs-11% and herbaceous plants -74%.

According to the biological form, the species of herbaceous plants predominate, and the highest amount of honey in the forestry fund is harvested during the flowering period of trees and shrubs.

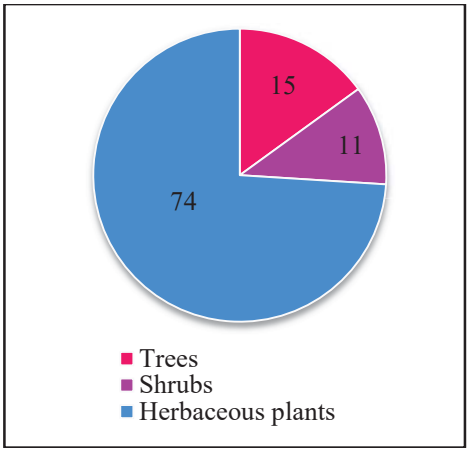

Fig. 2 Biological form of forest melliferous species, %

Systematization of forest melliferous plants by biological cycle offer information about surfaces which ensures collection of nectar and pollen.

Life cycle is different due to the diversity of plants.

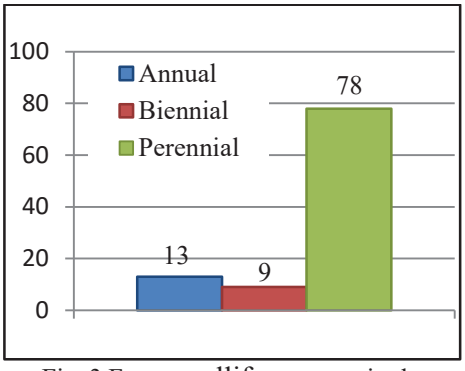

Fig. 3 Forest melliferous species by biological cycle, %

Figure 3 shows forest melliferous species by biological cycle: annual-13%, biennial-9%, perennial-78%. Grassy and woody plants are part of the perennial plant group.

Information on flowering phenophase of melliferous plants and its prognosis is very important for forestry and apiculture, because between the flowering period and occurrence of pollinating insects is a directly proportional relationship.

Figure 4 shows the percentage of melliferous species after the flowering phenophase, which were divided into two groups: spring (61%) and summer (39%).

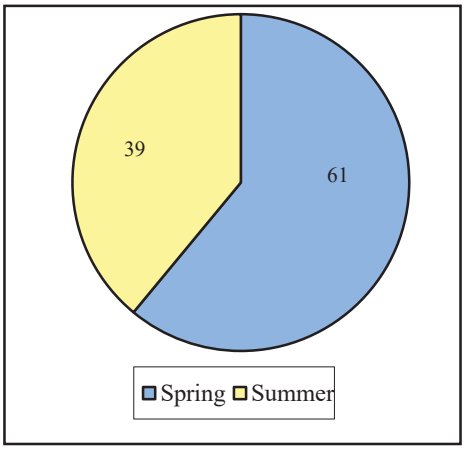

Fig. 4 Forest melliferous species after the flowering phenophase, %

An important source for bee feeding during early spring constitutes flowers of the plants that bloom first (hazelnut tree, dogwood, maple, willow).

Figure 5 shows the spring forest melliferous plants, identifying in 136 species and belonging to 32 botanical families.

In the group of spring forest plants there are predominant species from the following families *Fabaceae* (21 species), *Lamiaceae* (16 species), *Rozaceae* (13 species), *Scrophulariaceae* (18 species), *Ranunculaceae* and *Salicaceae* (7 species) Many botanical families are represented by 1-5 species (*Aceraceae, Amaryllidaceae, Apiaceae, Aristolochiaceae, Boraginaceae, Brasicaceae, Caprifoliaceae, Caryophyllaceae, Cesalpinaceae, Cornaceae, Corylaceae, Crassulaceae, Fageceae, Fumariaceae, Hippocastanaceae, Liliaceae, Malvaceae, Oleaceae, Resedaceae, Rhamnaceae, Sambucaceae, Staphyleaceae, Thymelaeaceae, Ulmaceae, Viburnaceae).*

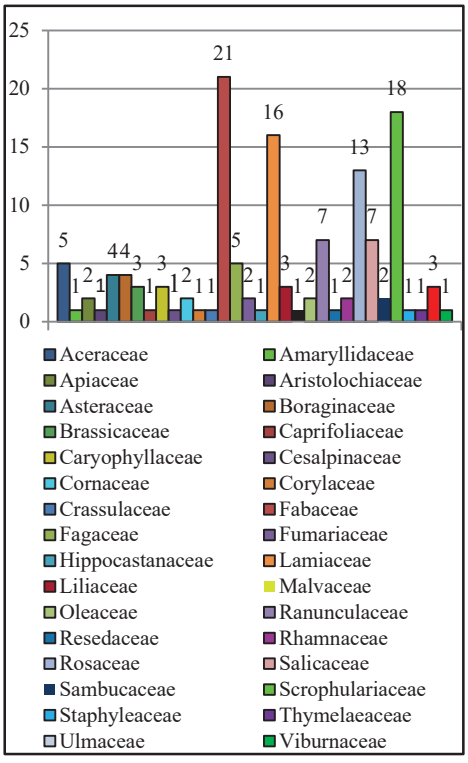

Fig. 5 Number of spring forest honey species

An important condition for the cost-effective growth and maintenance of bee families constitute information about melliferous plants from the area where bee-garden is located, flowering period of them, as well as their nectaro-polliniferous value.

All these data, as well as weather conditions make possible planning measures for rational development of a bee family, in order to obtain rich and constant honey harvests.

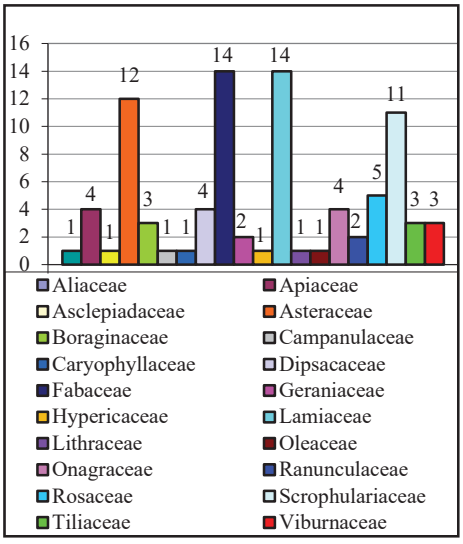

Fig. 6 Number of summer forest honey species

Figure 6 shows summer forest melliferous plants, identified in a number of 88 species belonging to 20 botanical families.

In this group predominates species from the families *Fabaceae* (14 species), *Lamiaceae* (14 species), *Asteraceae* (12 species), *Scrophulariaceae* (11 species). The rest of the families, 16 in number include 1-5 species. Families *Aliaceae, Asclepiadaceae, Campanulaceae, Caryophyllaceae, Hypericaceae, Lithraceae, Oleaceae* are represented only by one of honey forest plants.

For the rational use of the phytocenosis melliferous potential it is necessary to know the distribution of melliferous resources, phenology of flowering, the ability of nectar and pollen elimination. These processes are dependent on several natural factors.

Flora of the Republic of Moldova cover a number of melliferous plants remarkable for good honey production.

Figure 7 shows the percentage of apicultural economic share of inventoried forest species. Most species (46%) have a medium beekeeping share, 28% have a small share, and 20% are without weight. 1% from the inventoried species have a very high apicultural share (*Robinia pseudacacia* L., *Tilia* sp., *Rubus idaeus* L.), 5% from species (*Acer campestre* L., *A. tataricum* L., *Melilotus albus* Medik., *Onobrychis viciifolia* Scop., *Salix* sp., *Trifolium repens* L.) have a high apicultural share.

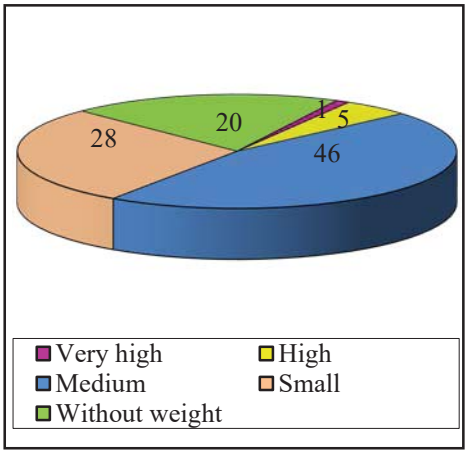

Fig. 7 Apiculture economic share of forest species, %

Interest for beekeeping products, especially for honey is steadily increasing. This kind of activity ensures preservation of natural ecosystems and development of biological diversity.

Actually, forestry enterprises, subordinated to Moldsilva Agency have around 900 families of bees, with an average productivity of 5 kg/honey/family. The majority bee families (67%) are situated on the territory of the northern republic's forestry enterprises (Edineț, Soroca, Glodeni, Natural Reservation ,,Pădurea Domneasca").

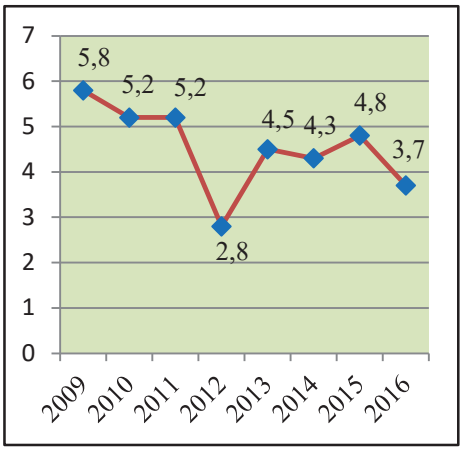

Fig.8 The amount of honey harvested by Moldsilva Agency, tons

Average productivity of sucrose in the forestry fund of the Republic of Moldova is approximately 256 kg/ha or 320 kg/honey/ha and can feed around 1.000000 bee families.

Data base provided by Moldsilva Agency shows that the amount of honey annually harvested decreases (http://www.moldsilva.gov.md).

Table 8 shows that during the years 2009-2016 the amount of harvested honey decreased from 5.8 tons during 2009 until 2.8 tons during 2012, then returning to 4-4.5 tons during coming years.

Superior utilization of the existing nectaro-polliniferous resources is an imperative for complete satisfaction of current requirements of the development of beekeeping production.

4. Discussion

Honey plants are the only source of organic feed for bees, which provides human beings directly or through bees with valuable biological products as honey, pollen, nectar, propolis, mother bee milk, bee wax.

Honey resources are part of the natural and cultivated ecosystems. Their rational evaluation and use is a current and perspective theme.

National forestry fund has a high melliferous capacity, but the annual share of collected bee products is among the smallest.

Being specie with a high apiculture share and comprising 1/3 of the forest area acacia is an underestimated melliferous resource thus reducing the income of the forest branch.

Honey is a product which is exported to the European Union and could bring major additional revenues to forestry enterprises. This is a reason to set up apiaries with professional staff.

Internationally, there are a lot of researches on melliferous forest resources, and internally these researches basically are missing.

The importance of beekeeping is proven by both scientific and practical research. It is known that the main pollinators are bees, which is not taken

into account and as a result negatively affects the profit of economic agents.

Providing the country with honey natural resources is an important economic factor in national development. The structure of these resources, their value, and quality, the degree of study and direction of capitalization, all of them have a direct impact on the economic potential.

Efficiency and yield of the forest fund may increase based on the complex and rational use of all resources under market economy conditions.

Utilization of the forest honey base has been recognized lately by the international community as a profitable business.

The use of honey forest products fall into the sphere of activity of various production and processing enterprises, and it is also a subject of increased attention for scientific, social and environmental organizations.

The melliferous productivity of forest resources is higher if floral biodiversity is more different and flowering period is longer.

Forest ecosystems have the greatest melliferous resources due to the diversity of plants.

Mixed and multi-tiered stands are more productive than the purely one.

There is an increase in the trend of moving to the principles of sustainable forest development in many countries of the world, through which economic viability, ecological responsibility and advantageous social use are achieved.

The gradual increase of the number of bee families and introduction of modern technologies for their growth and maintenance requires a number of effective measures to improve and expand the honey base.

During the period of years 2002-2008 on the degraded lands allocated by mayoralties forest plantations have been carried out on the area of 60000 ha. Most of these areas were covered with acacia (*Robinia pseudacacia* L.), which has significantly contributed to the increase of forest melliferous base of the Republic of Moldova.

More recently has been planted areas of about 1000 ha, with *Paulownia* trees that will be a very good malliferous source.

In parallel to the improvement and expansion of the honey base it is necessary to apply some measures for the conservation of nectaro-pollinifer resources and at the same time for biological protection of bee families.

One of the ways to solve the problem of sustainable forest development in the Republic of Moldova is a complete and effective involvement of non-timber forest products including melliferous products.

Expansion of market relations in the forest sector will create conditions for more dynamic development, efficient economic management of forests and formation of products for local markets, for a better respond to the needs of population not only in wood but also in other forest products.

Small number of bee families on the territory of the Republic of Moldova and uneven distribution of the melliferous plants determines the inability to use sufficient honey resources. It is possible to overcome

this problem by using of mobile beehives.

The action of bees solves a wide range of socio-economic problems from increasing plant productivity to providing people with unique apiculture products and for health maintenance.

Beekeeping is an important branch for the economy of the Republic of Moldova, but it families at the moment.

Improvement of melliferous potential can be achieved through the development of nectaro-polliniferous plants, afforestation, specific forestry operations, conservation of resources and protection of bees, limitation of grazing, use of productive bees, introduction of new species which will increase the capacity of forests, and at the same time will increase the areas occupied with valuable honey species.

Due to the multiple properties of honey, melliferous resources comprise an important component of non-timber forest products and determine taking into account the sustainable development of the forest sector.

Further study of honey resources will open new opportunities for humanity for their usage and management.

5. Conclusion

Melliferous plants are part of the group of non-timber forest products.

The inventoried forestry melliferous flora from the Republic of Moldova consists of 41 families, 129 genera and 224 species.

Most melliferous plants (61%) bloom in the spring and at the beginning of summer.

Spring forest melliferous flora of the Republic of Moldova belongs to 32 botanic families including 136 species. The most representative families of spring species are: *Fabaceae* (21 species), *Scrophulariaceae* (18 species), *Lamiaceae* (16 species), *Rozaceae* (13 species).

The summer forest melliferous flora lists 20 botanical families with 88 species. Families with most species are: *Fabaceae* (14 species), *Lamiaceae* (14 species), *Asteraceae* (12 species), *Scrophulariaceae* (11 species).

The most important species of honey plants in the forestry fund of the Republic of Moldova are: *Robinia pseudacacia* L. (600 - 1000 kg/honey/ha) and *Tilia* sp. (800 - 1200 kg/honey/ha).

Most of the melliferous species (46%) from forestry fund have a medium beekeeping share; with a very large weight is 1% and 5% with high weight.

Moldsilva Agency has around 900 of bee families with an average productivity of 5 kg/honey/family. The average sucrose productivity of the forestry fund from the Republic of Moldova is approximately 256 kg/ha or 320 kg/honey/ha and can feed around 1000000 of bee families. Production of honey obtained by the forestry enterprises is very low in comparison to private owners and melliferous capacity of the national forestry fund.

Most bee families (67%) are situated on the territory of the northern forestry enterprises (Edinet, Soroca,

Glodeni, Nature Reservation „Padurea Domneasca").

Improvement of melliferous potential can be done through afforestation, conservation of honey resources and protection of bees.

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