RESOURCE SIGNIFICANCE OF MEDICINAL PLANT POPULATIONS AS A RESULT OF THEIR LIFE STRATEGY EXHIBITION

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The resource significance of the plant populations in the context of the life strategy performance is considered. In our opinion, the state of resources of plant populations depends on their life strategy and various limiting factors. It is noted that the state and dynamics of raw resources of species with different life strategies largely depends on duration of achieving and retention of resource significance by the plant populations. The factors, which influence essentially on the state of resources of plant species with similar life strategies, were determined.

Keywords*: medicinal plants, populations, resources, life strategy*

Investigation of the mechanisms of biological potential realization in raw species populations and the particularities of functioning and structure of the populations in conditions of exposure to various destructive factors is a prerequisite for the understanding of plants resources formation. The state of plant species resources is the result of inter-relations between the individuals of population and its environment. It is determined, on the one hand, by genetically conditioned features of the species (the type and pace of ontogeny, morphology, raw performance, life strategy), vitality and spatial structure of populations, on the other hand by the presence of habitats that are optimal for the coenopopulations development, and the degree of the limiting factors' destructive impact on them (firstly – of anthropogenic) [2].

The interpretation of the "life strategy" concept, according to various authors, resolves itself into the explaining of the species populations behavior, aimed at the fullest use of environment [1]. The life strategy of the species, which is displayed through its populations, ensures the implementation of the species specific adaptation of the population to the influence of various limiting factors. For the purposes of resource studies it is important to make an analysis of life strategy in order to explain the particularities and patterns of raw resources formation. Theoretically, by the instrumentality of analyzing the life strategy, manifested in populations, the resource significance of any species of medicinal plants can be predicted. The purpose of this paper is to clarify the dependence of the state and dynamics of medicinal plants resources from their life strategy.

Materials and methods. For the assessment and management of populations and resources of the medicinal plants, mainly the characteristics of life strategy, proposed by J. Grime [1], had been

analyzed. They are: competitiveness (competitive power) – the ability of some plant species to suppress other plants through a combination of favorable characteristics, high energy of life-sustaining activity, high productivity and efficient use of the environment (*C*-strategy – competitive); phytocoenotic (environmental) tolerance is resistance, endurance in adverse conditions, the ability to exist for long under the stress by competitive species (*S*-strategy – stress-tolerant); mobility (responsiveness, synantropic ability) is the ability of a species to occupy quickly the territory, cleared of the competitors, due to high rates of reproduction and proliferation (*R*-strategy – ruderal). These features have been complemented by distinctive characteristics of a species life strategy, proposed by O. Smirnova [3]. Among the latter the ones that have high significance for resources are: ontogenetic features, types of recovery, the pace of development, the types and intensity of vegetative propagation and growth of biomass, raw productivity, types of age and spatial structures of populations, the maximum density of plant individuals, the rate of territory occupation and duration of its holding, reproductive capacity, ecologo-cenotic amplitude.

The characteristic features of plant species life strategies were analyzed to demonstrate the features of realization of the populations' resource potency and development of plant resources (including achievement and maintenance of the resource significance in populations). In order to clarify the peculiarities of the recourse capability of populations, the study was carried out on 90 species of medicinal plants, whose raw materials are used for official medicine in Ukraine.

Results and discussion. According to the results of the present study, the most resource significant characteristics of plants life strategy are the ones that

characterize the intensity of land settlement by plants, duration of achieving the resource significance of the populations, and the capability of holding it, the ability to realize the resource potency in ecologically or coenotically limited habitat.

It was found out that the populations of the most studied species (70%) have predominating features of S-strategy, 15% are R-strategists, 10% are C-strategists. And more than half of the species are characterized by intermediate characteristics of several types of life strategies (mainly RS-strategy), and for 5% of species of medicinal plants it is difficult to identify a certain type of strategy.

It has been established that antropogenic transformation of the environment generates favorable conditions for the development of populations and realisation of the resource potential for the species with the prevalence of mobility characteristics (R-strategy) and concomitant features of tolerance (S-strategy); considering that the areas, suitable for such species growth, are clear artificially and the limiting influence of C- strategists is eliminated. Through the intensive life sustenance, R-strategists form highly productive coenopopulations in short time. While populations of C-strategists achieve their resource significance, R-strategists have realized it a score times.

The quantitative resource indicators of plants with prevailing R-strategy features are defined mostly with the raw producing capacity of populations, representation (area) of ecosystems with the disturbed natural vegetation, where under the favorable conditions they quickly reach the maximal resource productivity (resource optimum), and the degree of anthropogenic pressure at the habitat. The duration of existence and resource significance of populations of such species is determined primarily by their biological properties and intrusion rate of species with the prevailing features of S-and C-strategies.

During the process of the natural restoration of the vegetative cover, R-strategists may be stored in communities for a long time, but the resource significance of their populations is limited in time. Raw importance of populations of such species decreases in inverse proportion to the increase of the anthropogenic pressure.

For example, *Capsella bursa-pastoris, Bidens tripartita* L., *Persicaria maculosa* SFGray, *P. hydropiper* (L.) Delabre occupy actively the areas with disturbed vegetation, participate in the composition of temporary communities with high density of individuals; their coenopopulations are highly productive. The short period of ontogenesis, high seed productivity and intense life processes ensured the maximum realization of their life strategy and resource significance of their populations in the short term. In case the coenopopulations of the species reach threshold values (maximal density of individuals, shoots, biomass), inhibition of their development and reduction of their resource significance takes place (even without the destructive influence of anthropogenic factors), due to limitations of environmental resources and development of coenotical competition. The duration of the resource significance maintenance for coenopopulations of R-strategists makes up from several weeks to several years, depending on the degree of anthropogenic pressure and intensity of ecosystems settlement by other plant species. Due to the strong anthropogenic transformation of vegetation the conditions, that are favorable for the formation of such types of resources, arise, but their quantitative yield depends on many factors and has random character.

Some species of medicinal plants with S-strategies characters domination are involved in the formation of secondary communities. In the early stages of the vegetation recovery they occur sporadically, sometimes form aggregations or occur dispersed. Duration of the resource significance achievement by such species' populations is species-specific and is dependent primarily on the biological properties.

Most of S-strategists have the features of an ecologic or coenotic stress-tolerant, some of these features are expressed simultaneously (*Crinitaria villosa* (L.) Grossh., *Ephedra distachya* L. , *Glycyrrhiza glabra, Juniperus communis* L., *Ledum palustre* L., *Potentilla erecta* (L.) Rausch., *Sorbus aucuparia* L., *Thymus pulegioides* aggr.). Signs of ecologic stress-tolerants reside in those species of plants that grow and form raw-significant populations in habitats that are extreme for other species (15%) (*Acorus calamus* L., *Actostaphylos uva-ursi* (L.) Spreng., *Calluna vulgaris* (L.) Hull, *Helichrysum arenarium* (L.) Moench, *Sedum acre* L., *Thymus serpyllum* L. In populations of many S-strategists (almost 45%) there are well defined traits of tolerance or resistance to coenotical impact of C-strategists (*Adonis vernalis* L., *Bistorta officinalis* Delarbre, *Colchicum autumnale* L., *Comarum palustre* L., *Convallaria majalis* L., *Corylus avellana* L., *Frangula alnus* Mill., etc.).

Coenopopulations of S-strategists are formed in various ecologo-cenotic conditions, therefore for each of the species there is characteristic species-specific set of limiting factors (trophic, antropic ets.). For example, the populations of *Bistorta officinalis, Comarum palustre* L., *Menyanthes trifoliata* L. are sensitive to fluctuations of humidity, while the state of *Helichrysum arenarium* et al. coenopopulations is almost independent from the lack of moisture. *Helichrysum arenarium, Menyanthes trifoliata, Convallaria majalis,*

Glycyrrhiza glabra are able to form productive populations with a high density of individuals. *Colchicum autumnale, Adonis vernalis, Potentilla erecta, Veratrum lobelianum* Bernh.*, Sanguisorba officinalis* L. are confined to the established communities, and form coenopopulations with low density of individuals and low resource significance. Most species of this group are characterized by a small ecologo-coenotical amplitude and have selective requirements to soil torpidity and humidity.

The realization of the life strategy and raw significant productivity of populations for these species are mostly limited by the ecologic (mainly fertility and humidity of soil) and anthropogenic (mainly pasturing or haying and recreation) factors.

C-type of life strategy is common in species that play a leading role in shaping the environment. The research of resources of the species with predominant qualities of *S*-strategy has shown that there is significantly more complex relationship between the type of plant strategy and its resource significance. These species are associated with stable ecosystems, they reach the resource significance in a long period and hold it long, their resources are well predicted.

Among the medicinal plants *C*-strategists are the following: *Alnus glutinosa* (L.) Gaertn.*, Betula pendula* Roth.*, Pinus sylvestris* L.*, Quercus robur* L.*, Tilia cordata* Mill. and others. They form or participate in shaping of forest communities, their populations are highly productive (as for medicinal raw materials). The moderate human impact on communities of *C*-strategists does not harm their resource potential. The resource value of such species is lost only if drastic changes of the habitats conditions occur (deforestation, dewatering or waterlogging etc.). However, in this case the effect of the habitat change at certain plants varies, too. For example, at deforestation the young plants of *Tilia cordata* receive the optimal conditions for growth and in several years they reach the resource optimum that is held until the restoration of the forest canopy. In the full-grown forest communities the insulation of the plants decreases and it limits the linden blossom productivity.

Conclusions. Each of the analyzed species of medicinal plants has a specific set of characteristics and limiting factors that promote the implementation of its life strategy including resource potential or restrict it. The state and dynamics of raw resources of the species with different life strategies largely depend on their role in the community, on duration of achieving and retention of the resource significance of plant populations. In the transformed environment the favorable conditions are formed for the realization of the resource significance of the species with dominant features of *R*-and *RS*-strategy. In the changing environment there are many threats that limit the resource potential for the species whose populations are characterized by prevailing conservative features of *S*- and *C*-strategies,.

References

1. Grime J.P. (1977). Evidence for the existence of three primary strategies in plants and its relevance to ecological and evolutionary theory. The American Naturalist - 111:1169–1194.

2. Minarchenko V.M. Life strategy of raw significance species of medicinal plants of Ukraine and its implementation in a transformed environment / / Ukr. botanical. Journal. - 2007. - 64, № 5. - С. 257-264. - Ukr.: Мінарченко В.М., Життєва стратегія сировинно значущих видів лікарських рослин України і її реалізація в умовах трансформованого навколишнього середовища // Укр. ботан. журн. – 2007. – 64, №5. – С. 257-264.

3. Smirnova O.V. Cenopopulations of plants (basic concepts and structure) / Moscow: Nauka, 1976. - 216 р. – Rus.: Смирнова О.В. Ценопопуляций растений (основные понятия и структура) — М.: Наука, 1976. — 216 с.

РЕСУРСНА ЗНАЧУЩІСТЬ ЛІКАРСЬКИХ РОСЛИН ЯК РЕЗУЛЬТАТ ВІДОБРАЖЕННЯ ЇХ ЖИТТЄВОГО СТРАТЕГІЇ

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Розглянуто ресурсна значущість популяцій рослин в контексті відображення їх життєвої стратегії . На нашу думку , стан ресурсів популяцій рослин залежить від їх життєвої стратегії і різних лімітуючих факторів. Відзначено , що стан і динаміка ресурсів видів з різною стратегією в значній мірі залежить від тривалості досягнення і збереження ресурсної значущості популяціями . Аналізуються фактори , які суттєво впливають на стан ресурсів рослин з аналогічною життєвої стратегією.

Ключові слова: лікарські рослини , популяції , ресурси , життєва стратегія