NATURAL POPULATIONS OF CULTIVARS FROM *PINUS* L. GENUS IN MOUNTAIN CRIMEA. PROBLEMS OF PROTECTION

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Introduction

Most specimens of the *Pinus L.* genus are valuable forest forming cultivars. The high-level tolerance of the pine to abiotical factors determined its wide spread over different climatic zones [35].

Pine forests of the Crimea peninsula play a very important role in providing the social and environmental needs of society. Their principal habitat is Mountain Crimea. The population of mountain arboreal plants is characterized by large genetic variety that determines their high importance for selection and silvicultural brunch.

In Mountain Crimea three pine cultivars grow naturally: P. *pallasiana* D. Don, P. *pithyusa* Stev. subsp. stankewiczii (sukacz.) N. Rubtz., P. *kochiana* Klotzsch ex C. Koch. [2, 59]. The last one is considered as relative to P. *sosnowskyi* Nakai (P.hamata Sosn.) or as a variety of P. *sylvestris var.hamata* (Stev.) Sosn., which differs by pyramide-shaped swollen and hooked folded corymbs at the bottom of the cone [35].

The most part of pine forests in the Crimea is naturally planted and refers to the protected territory. On the peninsula there is one of the oldest reserves of our country – the Crimean reserve, founded in 1923. As a matter of fact it ensured preservation of the main part of pine woodland. Ever-increasing recreational loads and as a result – fires, determined the necessity of two more reserves in 1973: Yalta mountain forest reserve and “ Cape Martyan”, which contains plantations of the southern macroslope of the Main Crimean Mountain Range. Since then it has been considered that natural plantations of *P. pallasiana* and *P. kochiana* gained the highest protective level. But stands of trees of *P. pithyusa* have still belonged to forestry enterprises, with the status of preserves (preserve “Cape Aya” – Sevastopol forest enterprise and “Novy Svet” – Sudak enterprise. But the status of preserve doesn`t ensure necessary protection of valuable tree cultivar, *P. pithyusa* is one of them.

Unfortunately, in spite of all entrepreneurial arrangements, at present time reduction of territory and natural population size of Pinus L. in Mountain Crimea has a negative trend. In accordance to records of Yalta mountain forest reserve for period from 1973 till 2013, 1139 fires have happened within its territory, the total afire area has made 2483,53 ha, approximately 22,4% of the reserve forest area. Most of fires took place among *P.pallasiana* plantations.

Based on the current forest condition and its role, at present time the most important task is throughout analysis and assessment of existing approaches efficiency and applied methods of agriculture, protection and renewal of the forest pine biocenosis. It`s necessary on a large scale to implement and use methods, firstly considering social and ecological forest role, what has primary importance for the Crimea Peninsula as a foreground territory of agricultural, resort and recreational development.

Last decades working out scientific and methodical concepts of protection and renewal the disturbed forest cenosis, population and genetic approaches have become widespread. The population analysis, using different methods of Biology and mathematical simulation, is one of the principal and promising directions in learning mechanisms of changeably species, peculiarity of their adaptation in definite growing conditions.

In accordance to modern ideas, population is a group of individuals of one species, that have inhabited definite area for many generations, where the exchange of genetic information is possible. A population is an elemental unit of the evolutional process and form of the species existing. The level of genetic diversity determines evolutional species resistance [8, 24]. Each population has its own evolutional destiny. At the same time level of genetic diversity supplies population resistance and possibility of its stable renewal [1]. The population has complicated biochorological structure according to its density, classification of specimens by age groups, types of growth.

The most important factor in population forming is natural selection. The natural selection is the statistic phenomena, from the point of modern concepts, otherwise the best genotype is more tenacious [8, 56].

The mechanism of the natural selection by means of growing conditions is the basis of approach in assessment of population size of arboreal plants, that is confrontation of species changeability in the region to the landscaping and geographical structure of this region. It`s assumed that in similar landscaping geographical conditions a definite type of forest growth condition is formed, that is the basis of the native forest types, making one population. In this case, vectorized mechanism of the natural selection is taken into consideration, which for a long time on the basis of the similar forest growth conditions has formed stands of trees with common gene pool namely population [33,43].

In a number of studies there is a high level of population adaptation to different growth conditions [44,45,53]. It`s well-known that populations in the similar conditions hardly differ even if to isolate them and on the contrary, population with active gene interchange in the definite selection way are able to change independently. The natural selection reveals its mechanism not only through abiotic environment, but also through organisms interrelations as inside of one species as through interspecific correlations in phytosenosis.

In natural populations there is a genetically determined polymorphism of resistance to effect of various factors. Increasing of changeability is one of the most important adapted responses to stress, as under radically change of environment, population is able to exist only if some specimens of population survive, which will ensure breed forming under new conditions. Selection of variants mostly adapted to new conditions change average of quantitative characters. Thus changeability increasing reflects the rate of adaptational processes inside of population. Inequality of average morphophysiological characteristics is a quantitative measure of changes due to selection. In general adapted potential of the species is determined by ability of quick changing morphologically in accordance to rhythm of variations of the basic essential natural and climatic environmental factors [4, 20].

Conception of plant population stability is associated with critical state which is connected with irreversible changes of their structural and dynamical organization. Objective character of the population critical state is disorder of the usual generations cycle, which makes forming and preservation of viable diasporas impossible. Critical state of population is assessed in accordance to changeability level of its demographic components, which are evaluated on the ground of analysis the level of incomplete age structure of populations in comparison with basic data.

The level of population stability is effected by changes of age composition, individual vitality, time of ontogeny periods, development of reproduction processes [10]. Stable space-time existence of populations is determined by change of demographical elements, their heterogeneity, which is supplied by multiple-aged individuals and polyvariant ontogeny. Polyvariant ontogeny and ability to change vital state are the most important mechanisms of population stability in the range of environmental and phytocenotic conditions [11].

Different factors effect on ratio of demographic elements in pine populations, such as abiotical factors playing the most considerable role. In Mountain Crimea at first stage of ontogeny moisture regimen has the principal effect on self-seeding process in natural pine populations [13, 51]. Under lack of moisture seed sprouting becomes slower, loss of geminating ability effected by soil micro flora is caused by lack of moisture as well [47].

The moisture regimen of arboreal plants is closely connected with the dynamics of soil moisture. In stand of pine trees soil drying across happens irregularly. In the upper half meter layer the most replete by plant roots, moisture is used faster. On the depth of 20-30 sm moisture is used for transpiration, in the upper 10sm layer it goes for physical evaporation [52]. Growth of young pine plants with root system in 10-15 sm soil layer is limited by herb layer to a large degree. Intensively growing herb plants supplant pine roots out of upper to lower, less fertile soil layers, that reduces growing capacity of seedlings. In seasons with enough moisture herb plants use the same quality of moisture as 19-years dense pine cultures, in dry years herb plants use more moisture than 30-years cultures [25]. According to Shumakov V.S. and Kurayev V.N. (1973), with dense herbage 0,4-0,6 a considerable inhibition of pine is marked [54]. It is one of the reasons of mass death among self-seeding across the area of cutting. In accordance to Gordiyenko M.I. and Gordiyenko N.M. (1988), level of pine self-seeding in pine forests and subors of woodlands is registered before cutting, in a year of cutting and a year after it. Henceforth pine seeds sprout but because of intensive herbage spreading, plantlets don`t meet the competition and majority dies in spring [6].

In this connection phytocenotic mechanisms keeping stability and resistance of pine assemblages play an important role. Golubets M.A. and Tsarick I.V. (1990) consider stability as an integral index of resistance. [5]. They suggest not to indentify notions of biotic systems stability and resistance, but to consider resistance as an ability of a system to reserve its structural and functional properties and renewal them quickly in reply to natural and anthropogenic effects; and stability is considered as an capacity of a system to reserve its basic parameters during the whole existence or during its continuous period of development.

Researching pine biocenosis based on microenvironmental and system approach using quantitative methods, analysis of structure chorologic changes and functions of stand of trees-edificator was carried out. By means of prevailed types of pine forests in Mountain Crimea the principal role of stand of trees-edificator in forming of phytoenvironment, structure and functions of the main components in forest biocenosis was marked out [15, 30, 31].

If to consider biocenosis as a system, mainly created by process of environment forming, tree role in the assemblage is defined by its edificator power [46]. Time when effect of the given individual reflects on other plants state is characterized as a quantum leap. Intensity phytogenetic field depends upon plant size and age. This statement is approved by most researchers, who defined indexes of tree phytogenetic field in their works [21,57]. The most effective places of stand of trees are usually close to large old trees. Though role of a specimen in the assemblage isn`t limited by this function, competitive status of a tree in synusia is quite important. Tolerance and competitive power of species in an over-ground cover differ, edificator power of woody specimens in different environmental conditions is diverse as well.

Future of a young pine generation in forest assemblages is determined by complicated processes of plants interrelations due to competition of adult trees for light, nutrients and soil moisture. Assemblages of diverse types differ markedly from each other in nanorelief, mosaic and area of their microstations and synusias of lower layers. It determines heterogeneity of biocenotic environment regimens, causes variety of growth conditions, significant space differentiation of sprouts, their localization in connection with microstations peculiarity in biocenoses [12]. According to some observations, on the ground of different adverse factors, biochemical interactions play definite role in the root system zone by means of root products of adult trees and other components of phytocenosis [55]. In spite of the principal factor in given conditions, result of the common effect leads to the total or partial elimination of sprouts and young growth. Survived part of pine young growth under the crown layers of stand of trees differs from open-growing trees of the same age by disordered morphogenesis and changed correlation of physiological processes intensity. Morphological characteristics of inhibition become apparent first of all in changing of general habit and crown form [11,48].

Inhibited young growth being under closed forest crown is characterized by reduction of photosynthesis, breath and transpiration intensity. The pine young growth thrives on that area where negative effect of climax vegetation of lower layers is absent. Conditions of mineral nutrition, moisture, temperature and illumination regimen are more favorable for plants. Such conditions are typical on locations with single and group falls of the oldest trees [28, 37, 58].

On the whole pine self-seeding has ruderal properties, such as: high degree of light-requiring, low shade tolerance of self-seeding and as a result its inability to survive under closed vegetable crown for a long time, drought-, heat- and frost-resistance of sprouts, deep establishment during first years of existence, intensive growth [39,40].

There is an opinion that low-intensive fires create favorable conditions for pine renewal. Most of works indicate that under close conditions of seeding, as a rule number of pine self-seeding is much higher on mineralized or burnt soil than on humic substrate [17].

In general growth and development of pine are close connected with fire effect. For instance, one of the proofs of pyrogenic adaptation of P. *sylvestris* is thermal isolation of the fulcrum bottom by rind with thickness of 1,5sm, it protects phloem and cambium from overheat [38]. Thickness of the rind becomes than bigger than higher above the soil, reaching maximum mark on level of 10-15 sm, then this characteristic goes down slowly in accordance to the vertical temperature profile during ground fires. Among morphophysiological peculiarities of pine trees which favor preservation and survival after fire besides thick rind at the bottom of the fulcrum there are strength of timber and root, strong development of main and “anchor” roots, lateral roots penetration, ability of injured tissue to tar and regenerate fast, high disposition of the crown [35,40].

Fires intensify trend to strong pine population. A small amount of young grow cohort on the areas, which hasn`t been subjected to fire effect for a long time takes place because seeds of dominant trees getting into the sward don`t have an opportunity to sprout [41].

There is a close negative correlation among a number of young pine grow generations and long absence of fires. The whole complicated process of direct and indirect effects of ground fires (destroying of a strong mat layer, increasing of illumination, moisture on the exposed soil surface, enrichment of soil by mineral elements, abolition of phytotoxicant effect, reduction of competition etc.) is a kind of signal for seed sprouting and active development of seedlings [18,19,38,49,50]. Pyrogenic cyclicity of young grow sprouting leads to staged age system of pine forests. Periodicity of renewal and age structure of pine populations are under similar influence of cycles of substrate erosion in mountains and agricultural cuttings, attended by mineralization of soil [32].

Seed renewal of pine on recent burning depends on if there are seeding sources and their allocation, combination of seed years with sufficient precipitation and other factors.

The first stage of post-fire renewal dynamics is characterized by maximum evenness of the space distribution of young pine grow, which being in the assemblages with 30% of injured stand of tree is regular or casual, but being in the assemblages with 70% of injured stand of tree this value changes as fire remoteness increases from group fire till accidental [7].

In subclimaxes the reason of changes of young grow density in definite periods can be irregularity of apolexis of even-aged and stage multiple-aged stands of tree.

The most widespread interpretation of the fire effects is change in phytocenosis state, which is possible to observe immediately after fire or next 5-7 years after it. These consequences can be considered as “short-term”. They include burnt trees and accretion changes of post-fired stands of trees, burn injuries and damage of tree crowns, lost young grow and undergrowth, changes of soil environment, living and dead ground cover [9, 26].

Nevertheless result of fires is not only qualitative and quantitative changes of stands of trees. Sequence of interdependent and correlated post-fired phenomena has effects as follows: change of environmental regimens in growing conditions, emergence of derivative assemblages on burnt areas, replacement of species and age generations. In general post-fired phenomena determine specific and direction of post-fired forest formation [14, 16, 18]. Above-mentioned consequences are possible to reveal and value if to assess allocation of vegetational succession stages in post-fired period within this or that region and their silvicultural and biological peculiarities [49]. At the same time special environmental background is formed, which determines peculiarities of post-fired vegetational successions. Post pyrogenic environmental background combined with burnt seeding areas predetermines ecological and dynamic lines of vegetation forming within elementary natural complexes. Each line is divided into morphologically different periods of regenerative aged post-fired dynamics, which may be considered as genetically correlated types of biocenosis [50].

Nowadays one of the most important questions is a dynamics of abiotical factors in pine stands of trees, damaged by fire. This problem takes on special significance due to increasing of anthropogenic fires and necessity to improve efficiency of reafforestation work within burnt timbers, what is highly actually for ecosystems of Mountain Crimea. In general, to reveal dynamics` regularities of ecological factors and their effect on development of forest phytocenosis is the key condition in forming of high-productive plantations [14, 15, 30, 34].

At present anthropogenic effect becomes a crucial factor in forming of forest ecosystems. It concerns compulsory monitoring of long-term purposeful monitoring systems, providing effective control and prognostication of mainly anthropogenic changes in the natural environment. Long-term monitoring process of the natural populations of the cultivars from *Pinus* L. genus in Mountain Crimea is essential to control pine forests state, assess their structure, productivity, level of recreational exploitation, prognostication of probable changes, destroying stability of the forest biocenosis. Thereupon factor of time takes on primary importance, the sooner tentative areas are formed and monitoring is actuated, the initial characteristics of researching objects more correspond to the performance of their natural virgin state. More long-term chronological lines of observed parameters allow improve informative capability of performances, characterizing tendencies in the state dynamics of researching objects.

Protection of different plant cultivars, solution of problems, preservation of biodiversity demand constant improvement in assessment system of the vital state, which is necessary for objective analysis of changes in the natural populations development, prospect to preserve their ecological potential. The most important problem of present is to form database of bioecological characteristics of natural populations of forest forming tree breeds of Mountain Crimea. The database should rely on performances of vital state, peculiarities of specimens response to environmental changes. One of the most perspective ways to solute mentioned-above problems is to apply biophysical methods for assessment of the plants vital state in the field conditions.

Analyzing plant state, biochemical methods gain a large importance, as that allows detect negative effects of different factors before their damage influence becomes apparent. That`s why, applying monitoring system for forest ecosystems demands wide use of biochemical indicators of arboreal plants state.

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The article presents modern conceptions concerning population-genetic methods to analyze mechanisms of cultivars changeability, specific features of their adaptation in terms of dynamics of growing conditions. It is shown that presently anthropogenic impact gains an importance of the determining factor in forming and development of forest phytocenosis. One of the main tasks to provide objective control and prognosticate changes of natural populations state including cultivars of *Pinus* L. genus in Mountain Crimea is monitoring system and forming database of their bioenvironmental characteristics.

Key words: ecology, adaptation, phytocenosis, protection, natural populations, *Pinus* L.