

Structure, area distribution and condition of pistachio forests in Kyrgyzstan

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ABSTRACT

The article provides information on the distribution of the area of pistachio forests by altitude, slope exposures, age classes is given. Growing on slopes of different exposures, pistachio and sparse forests fulfill soil-protective, water-protective and water-regulating role. The diversity of pistachio forms allows selecting the best forms for introduction into culture. Pistachio forests serve as a source of valuable nuts for the local population. In harvest years, the collection of pistachio fruits brings good income to the local population. However, it is necessary to work together with the local population on sustainable use of pistachio plantations and preservation of their biodiversity, as there is a negative impact of anthropogenic factors. The data on the impact of major pests and diseases of pistachio plantations are presented. Due to the influence of pests and forest diseases, the yields are reduced and the condition of pistachio forests deteriorates. Timely and effective control measures against forest pests and diseases are necessary. Analysis of the current state and solution of the issues of biodiversity conservation of pistachio plantations is of great scientific and practical importance.

Keywords: Biodiversity, forest areas, pests, pistachio diseases. pistachio forests, yield

INTRODUCTION

The total area of forests in the world is 4.06 billion hectares, or 31% of the total land area and contain more than 80% of terrestrial biodiversity (FAO, 2020). According to the Global Forest Resources Assessment (FAO, 2020) 398 million hectares of protected forests cover 12 percent of the world's total forest area. In four countries, the share of total forest area with soil and water protection functions exceeds 90 percent - Kiribati and Kuwait (both at 100 percent), Cape Verde (98 percent) and Kyrgyzstan (92 percent). The Kyrgyz Republic is a mountainous low-forest country and about 90% of the area is at an altitude of more than 1500 meters above sea level (Okruzhaiushaia sreda v Kyrgyzskoi Respublike- 2015-2019, 2020). All forests of the Kyrgyz Republic are under state ownership and are national wealth. The total area of the state forest fund is 2,619.7 thousand hectares. These forests store the gene pool of many species of not only tree and shrub species, but also

herbaceous plants, as well as a source of income for the local population and play a key role in the economy of the country.

Of the 4,500 species of plants in the State Forest Fund of Kyrgyzstan, 300 wild plants are rare and endangered, 125 species are endemics, 200 are medicinal plants, and more than 180 species are woody and shrubby plants that make up the forests of the Kyrgyz Republic. In addition, more than 65% of the total composition of endemic plants grows in the forest area. They constitute the main core of plant communities of forest ecosystems of the Republic, and they cannot be replaced by foreign species (Murzakmatov *et al.*, 2016). According to remote zoning data obtained as a result of space images processing, about 1.2 million people live at a distance of up to 5 km from the forest and use its resources. About 200 thousand people live inside the forest and are fully dependent on forest resources. The population's needs for firewood and construction material are growing every year, it was found that one family uses about 5-10 cubic meters

of firewood for heating and cooking per year (Bikirov *et al.*, 2018).

One of the most characteristic for the lower part of the nut-fruit forest belt are sparse forests formed by pistachio (*Pistacea vera* L.) and almond (*Amygdalis* sp.) with a total area of 45840 hectares (Okruzhaiushaia sreda v Kyrgyzskoi Respublike-2015-2019, 2020). Dry growing conditions are the main reason for the sparseness of pistachio plantations (Mamadzhanov and Kenzhebaev, 2022). In harvest years forestry enterprises and local people collect mountain fruits. Walnut over 2000 tons; pistachio 52 tons; wild apples within 5000 tons (Toktoraliev and Attokurov, 2009). Currently, the state of nut and fruit forests is relatively stable, but there are localized threats such as unsystematic grazing (Wilson *et al.*, 2019), excessive harvesting of medicinal and technical plants, still lead to forest degradation.

METHODS

Field surveys were conducted to assess the structure, area distribution and phytosanitary status of pistachio forests in Zhahal-Abad, Osh and Batken regions of the Kyrgyz Republic. The coordinates of the sample area points were determined using a Global Position System (Garmin GPS) device.

RESULTS

According to FAO (FAO, 2022), the world production of pistachios was more than 915717 tons. The leading pistachio producing countries are USA, Iran, Turkey and account for 84.9% of the total volume. According to statistics, Turkey produces 144000 tons of pistachio annually (Mikdat Simsek, 2018). Pistachio, *Pistacia vera* L., is one of the main forest-forming species of walnut-fruit forests. The total area of pistachio forests is 34403.3 ha (of which 4622 ha is outside the territory of the state forest fund) or 3.4% of the total forest area of Kyrgyzstan and is concentrated on the southwestern slopes of the Fergana Range and Chingir-Tash mountain massif. Pistachio forests of Kyrgyzstan have a huge gene pool that allows selecting the most productive, stable and economically valuable forms, which are not inferior in nut quality to cultivated pistachio varieties. The study of form diversity of pistachio forests of Kyrgyzstan makes it possible to select high-

yielding economically valuable forms promising for creation of highly productive plantations. The form diversity of pistachio can be classified according to the shape of the crown, fruit brushes and nuts (fruits), pericarp coloring, yield, nut size and openness, etc.

Pistachio trees are found with spreading, globular, compact and occasionally “weeping” crowns. Pistachio trees with a spreading crown form are found on gentle slopes at an altitude of 800-1400 m above sea level. They are characterized by relatively good growth and yield. Globe-shaped crowns are formed by single-stem (boll) pistachio trees, and they are rarely found. Compact (umbrella-shaped) crown form is found in all types of pistachio trees. Very rarely found trees “weeping” crown form grows on more fertile soils at an altitude of 1000-1200 m above sea level. Basically, the nuts of the true pistachio are divided into 3 groups: globular, oval, and elongated-oval. One of the qualitative indicators is nut openness. The character of nut opening can be up to the base, up to the middle of the knuckle and on the top. The average openness of pistachio nuts is 66% in Southern Kyrgyzstan, and in the north of Kyrgyzstan it is 37-22% (Bolotov and Kenzhebaev, 2008). Pistachio forests in Kyrgyzstan are mainly represented by middle-aged plantations-23.7 thousand ha or 65 % of the total area (Table 1).

Pistachio forests in Kyrgyzstan are distributed at altitudes from 720 meters to 1900 meters above sea level, but sometimes there are isolated pistachio thickets at an altitude of 450 meters above sea level. Optimal altitudes for pistachio are from 700-1500 meters above sea level. At these altitudes (700-1500 meters above sea level) pistachio develops normally and gives a good harvest. Pistachio forests in Kyrgyzstan are mainly distributed in southern exposures, the area of which is 13903.2 hectares or 40.4 percent of the total area of pistachio forests (Fig. 1). The distribution of natural pistachio forests on the slopes of southern exposures indicates its drought resistance and adaptation to harsh soil conditions.

Unfortunately, despite the exceptionally high economic and economic value, pistachio forests are currently in unsatisfactory condition, especially adjacent to populated areas due to anthropogenic

Table 1: Distribution of pistachio plantations in Kyrgyzstan by age classes

Prevailing tree and shrub species	Total (ha)	by age group (ha)					
		Juvenile		Middle aged	Early-mature	Mature and over mature	
		I class	II class			total	Including over mature
Pistachio	34403.3	1989,3	5494	16350,5	5360,3	4096,1	1108,8

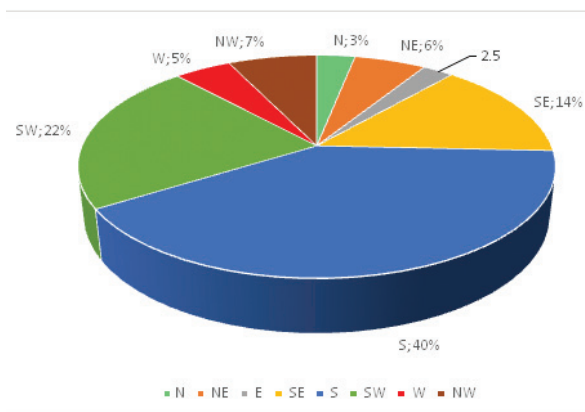


Fig. 1: Distribution of pistachio trees by exposures (%)

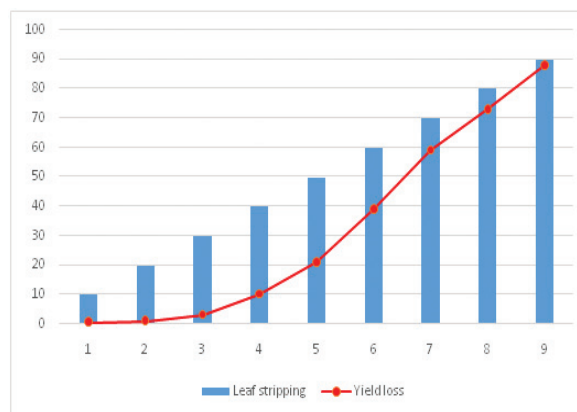


Fig. 2: Yield losses of pistachio as a function of the degree of leaf stripping

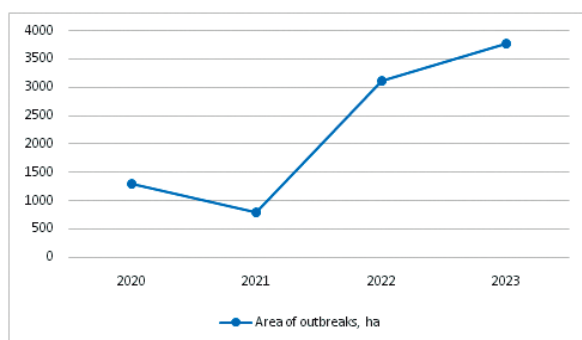


Fig. 3: Dynamics of gypsy silkworm foci in pistachio plantations

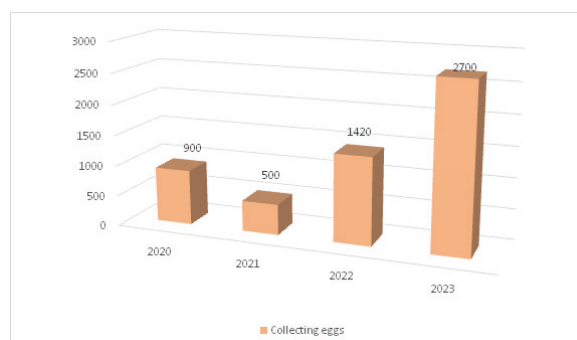


Fig. 4: Collection of gypsy moth egg-layers in pistachios

pressure. Grazing in pistachio forests destroys natural regeneration of pistachio and unsystematic grazing worsens soil water permeability and creates conditions for erosion processes. As a result of unregulated grazing the area subject to erosion expands. Low productivity of pistachio plantations is explained not only by insufficient care, damage from pests and diseases, but also by the ratio of male and female individuals. Male non-fruiting individuals of pistachio occupy more than 50%, *i.e.* the ratio of female and male individuals is close

to 1:1.75 sometimes 1:2 (Bolotov and Kenzhebaev, 2008, Kenzhebaev *et al.*, 2019).

Besides, pests and diseases take a noticeable toll on the pistachio forest crop. Some damage the pistachio kernels, and some of them feed exclusively on leaf tissue, and if the leaf laminae are severely damaged, the tree becomes noticeably weaker, which affects yields. The main pests of pistachio are gypsy moth and pistachio moth. The gypsy moth (*Lymantria dispar* L.), in conditions of Kyrgyzstan annually gives mass outbreaks and is the most dangerous pest not only of pistachio

plantations, but also of other forest-forming tree species of nut and fruit forests. From the harmful activity of the gypsy silkworm forestry and local population annually suffer huge economic losses. The gypsy silkworm is found in foothill and mountainous areas at an altitude of 700 to 2000 m above sea level. The most extensive areas of outbreaks are observed in the lower, pistachio zone (Ashimov, 1989; Orozumbekov, 2001; Orozumbekov *et al.*, 2005; Teshebaev, 2008, Toktoraliev *et al.*, 2021).

Below we present yield losses of pistachio from harmful activity of gypsy moths (Fig. 2). Losses of pistachio yield depending on the degree of leaf stripping up to 30% are not significant, i.e. up to 3%, and with complete stripping the yield is reduced by 90%, and sometimes lost completely (Ashimov *et al.*, 1998).

According to the data of Zhalal-Abad forest protection station, in recent years the area of mass outbreaks of gypsy silkworm ranges from 1300 to 3785 hectares (Fig. 3). The palatine silkworm periodically gives outbreaks of mass reproduction migrating along vertical height from pistachio sparse forests to upper nut plantations. Measures to control gypsy moths are carried out by collecting eggs and pupae, using entomophages and biological preparation Virin-ENSh(k).

In order to reduce the number of the pest, forestry workers and forest users annually collect several hundred kg of gypsy silkworm eggs, in 2020 collected 900 kg, and 2023 it was 2700 kg (Fig. 4).

The biological preparation (Toktoraliev and Attokurov, 2009) which is a liquid viral insecticide of domestic production, is also used against the most dangerous pest. The preparation has no toxicity and is not pathogenic for warm-blooded animals, bees, etc. Oviposition of ovipositors is carried out by wetting or spraying. Entomophages are used against gypsy moths. The composition of natural enemies of entomophages is diverse. Currently, as the main entomophagous against the gypsy silkworm, the forest caterpillar hunter (*Calosoma sycophanta* L.) from the family *Carabidae* L. Annually, more than a thousand beetles (*Calosoma sycophanta* L.) are bred in the Zhalal-Abad forest protection station and they are used to exterminate larvae and pupae of the gypsy silkworm. The beetles and larvae of the odoriferous

beetle are very mobile and during the growing season they destroy up to 200-300 caterpillars and up to 20 pupae of the gypsy moths (Sultanov, 1998). The use of biological preparations and entomophages to protect pistachios is the safest for forest ecosystems and a promising way to reduce the number of pests.

Pistachio leaf and fruit septoriosiis is one of the most common diseases in all pistachio growing areas (Uda Nezar Muhamad, 1989; Gusella *et al.*, 2021). Pistachio forests in Kyrgyzstan are often affected by septoriosiis (causative agent *Septoria pistacina* Allescll.), which negatively affects yield and fruit quality. The area affected by septoriosiis in 2020 amounted to 1220 hectares, and in 2023 it was 2212 hectares. At first, small brown spots appear on affected pistachio leaves. As the disease develops, the spots gradually grow and cover the entire leaf lamina. In the conditions of Jalal-Abad oblast, the first signs of septoriosiis are observed in mid-May. In July, mass infection is observed and leaves shrivel and fall off, as a result, the process of photosynthesis is disturbed, yield (incomplete kernel development) and annual growth is reduced, which in turn affects the future harvest.

Preservation of biodiversity of pistachio plantations, improvement of their condition and sustainable use, increase of yields, expansion of areas through the establishment of industrial plantations, protection and defense against forest pests and diseases are the main tasks of forest science, forestry and forest users.

CONCLUSIONS

1. Pistachio forests of Kyrgyzstan is one of the valuable forest areas and by the occupied area and diversity of forms is one of the large forest areas in Central Asia.
2. The main massifs of pistachio forests are spread below the belt of walnut forests at an altitude of 700 to 1400 m above sea level.
3. In terms of age, middle-aged pistachio plantations prevail, but there are areas of overmature plantations where reforestation measures should be taken.
4. Many areas of pistachio forests are distributed on slopes of southern exposures and therefore pistachio can be cultivated in arid areas.

5. It is necessary to establish new plantations and increase the yield of pistachio plantations.
6. Improve the effectiveness of forest pest and disease control measures using biological and modern control methods.

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