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# RAISING PRODUCTIVITY OF CROP YIELDS DUE TO FIELD-PROTECTING SHELTERBELTS IN KHERSON REGION

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*Встановлено, що для сучасних сільськогосподарських угідь Херсонської обл. характерними є певні негативні ознаки, такі як ерозія, дефляція, зменшення врожайності тощо. Одним із методів боротьби з цими проявами є лісові смуги напівпродувної конструкції. Досліджено, що вони зумовлюють рівномірний розподіл снігового покриву на полях, знижують показники ерозії та видування ґрунту, позитивно впливають на врожайність сільськогосподарських культур. На жаль, на сьогодні лише 12–15% лісосмуг області збереглися у функціональному стані і здатні виконувати такі завдання.*

***Ключові слова:*** *врожайність, Херсонська область, лісосмуга.*

Geographical and physical conditions of the Northern Black Sea area defined its agricultural development. Along with favorable, there some negative agro climatic conditions. One of the most effective ways of combating adverse agro climatic conditions is field protecting forest planting. It contributes to accumulation and preservation of moisture in the soil, prevents soil blowing, reduces evaporation of moisture and protects field crops from dry winds and freezing.

Most protecting forest plantations are illegally cut by local residents every year or are terminated by fires or diseases. Thus, to improve the quality and efficiency of shelter belts, it is necessary to undertake certain actions for their preservation, restoration and monitoring.

## MATERIALS AND METHODS

The study is based on the field materials researched by the author during expeditions and the materials received in similar facilities during 2011–2013 years in the Northern Black Sea area. They include laying 22 test plots, about 50 geobotanic and forest typology descriptions, 87 herbarium specimens of higher vascular spore plants, mosses and lichens, 7 diagrammatic maps of different scale.

The elements of conventional methodology, which combines monitoring methodology for forests of II level within the program FHM (Forest Health Monitoring (FHM) developed by the Forest Service (Forest Service, US Department of Agriculture) and the Agency for Environmental Protection (US Environmental Protection Agency, USA), have been used and the methodological approaches for monitoring of II level within the program ICP Forests, which are described in the «Manual on Methods and Criteria for Harmonized Sampling, Assessment, Monitoring and Analysis of the Impact of Air Pollution on Forests» (Coordinating Center program ICP Forests, m. Hamburg, Germany, 2010) [1–3].

Laying test plots was carried out according to standard methods by СОУ 02.02-37-476: 2006 «Test Forest Planting Plots. The method of laying»

## RESULTS AND DISCUSSION

As the results of our research show, shelterbelts on the territory of Kherson can hardly perform their functions. Only 12–15% of shelterbelts meet performance criteria. They consist of more than 3 rows of trees; have a few (3–5) levels in the vertical structure; a shrub layer may be observed; there is slight damage of tree crowns and trunks; a recovery process takes place.

Most of the belts in Kherson region are species that are adapted to relatively harsh environment of dry desert and can grow without any additional reclamation interventions such as Robinia *(Robinia pseudoacacia* L.*)*, tree-thorn honey locust *(Gleditsia triacanthos* L.*)*, American maple *(Acer negundo* L.*)*, ash *(Fraxinus excelsior* L.*)*, Ailant the highest *(Ailanyhus altissima* Mill.*)*, less oak *(Quecus robur* L.*)*

A few aspects cause failure in protection and agro-forest-reclamation functions of shelterbelts in Kherson region that has been confirmed by our long-term research.

One of negative trends is the fact that there are a number of shelterbelts that don't have a single owner – only 1557.67 hectares are assigned to the state forestry enterprises, 315.4 hectares – to agro forestry enterprises, 1100 ha – to farms, 258.84 ha – to citizens and 701 ha – to other entities. The total area of the land under forest belts secured by entities is 3934.03 ha or 13.6% of the total land area covered by shelterbelts. Of twenty-one districts of Kherson region, only 12 have belts that are assigned to state forestry enterprises; and areas such as Velykooleksandrivka, Vysokopillya, Gola Prystan, Hornostayivka, Ivanovo, Kalanchak, Nyzhni Sirohozy, Novotroitske and the city of Nova Kakhovka do not have shelterbelts assigned to state enterprises.

The overall pattern for protective forest plantations in Kherson region is failure to operate erosion and wind holding functions. This has led to the increase of erosion processes which generally comprise from 27 to 59% of the arable land area. Yields of crops, according to the Department of Agriculture and Food in Kherson region, are directly correlated with the quality of shelterbelts and that is why agricultural production requires additional resources [4].

Analysis of the materials has revealed a disastrous situation with quantitative and qualitative indicators of the shelterbelts. In particular, the deterioration of their state is conditioned by:

- Firstly – the absence of any agro reclamation and forest protection measures;
- Secondly – the local population uses tree shelterbelts in large scale as a source of fuel procurement;
- Thirdly – the vicinity of shelterbelts with intensively cultivated fields, results in a negative impact of herbicides, etc.

The belts that perform protective functions increase the yields of grain and technical crops that prevail in the structure of the crops rotation in Kherson region. According to our observations and the analysis of the materials of the Region Department of Agriculture, due to field shelterbelts on the territory of Kherson, gain of the main crops – namely, winter wheat amounted 4.1 kg/ha, maize and spring barley – 3.3 kg/ha, spring barley – 52 kg/ha. This process occurs mainly on the grounds surrounded by belts of lacy or lacy blown structure. The shelterbelts of this type have slight clearances that are more or less evenly dispersed around the longitudinal vertical profile band and cover approximately 15–35% of the total area of the profile. They consist of trees with a small number of shrubs, rarely with only trees, and are placed along fields. The peculiarity of turbulent flows formation in these plantations is that they provide even distribution of snow cover over the entire area of the field. Belts of other structures – blown and dense, do not provide such snow retention. In blown forest belts the distribution of snow is chaotic, in dense ones – snow amasses on both sides of the shelterbelts themselves. On farmland surrounded by forest lacy belts with even distribution of snow cover, in

January-February 2012 soil freezing decreased compared to the averages by 20–36 cm and became 12–37 cm. That had a positive effect on survival rate of winter crops, as well as on accumulation of moisture in the soil in spring.

On the other hand, even snow cover in areas between lacy forest belts contributed to weakening winter wind erosion and absence of removal of the upper horizon soil humus layer.

The main purpose of forest plantations in the steppe is to improve the overall environmental state of the territory and protect fields from the negative effects of the continental climate [5]. Creating forest plantations in Kherson region is the key to sustainability of agricultural production, is a perspective for solving the food problem and nation security; forest shelterbelts protect soil and water, perform water distribution and sanitary-hygienic functions. Consideration of main environmental factors such as relief of the area, directions of prevailing winds, rainfall quantity and quality and organization of the territory affect the efficiency of shelter plantations.

One of the main functions of protective forest plantations is to regulate wind conditions in the pre-surface layers of the atmosphere. Forest plantations, which are located on the fields in the form of bars, change the motion of turbulent air flow, slow wind speed, lower its mechanical action power. Reduction of wind speed depends on the aerodynamic characteristics of the forest zone and its condition. The study of the impact of the forest belt system on the wind has shown a consistent increase of the zone of effective influence on the first through the fifth band. If the range impact gradually increases, the wind speed behind the fifth band is less than behind the fourth one. The densest belts reduce the wind speed up to 0, medium dense and partially blown bands – by 50–70%, and leaky blown – by 20–50% of the wind speed in the open field [6]. The ability of forest belts to pass air flow is affected by the lace of tree crowns and their foliate condition. It should be considered that the belts of pure trees composition, which have lacy crown without shrub undergrowth, are less wind-proof because of low efficiency and poor biological stability (Zhiganov, 1977).

According to V. Lebedev and B. Logginov, planting forest belts around irrigated fields can prevent harmful effects of dry winds and provide high yields of crops. Shelterbelts hold back air flows, reduce their speed on in-between belt plots, and result in a longer retention of moisture and reduction of evaporation. [7].

Reduction of wind speed due to shelterbelts affects changes of other elements of the microclimate: air temperature, relative humidity, evaporation, which are essential for agricultural crops.

Forest plantations affect microclimatic conditions of habitats. Shelterbelts protect the soil from freezing, flooding and blowing [7]. The amplitude of temperature fluctuations changes throughout the day and season. There is an increase in temperature in the morning and evening in spring – a raise of the temperature above the soil, and in summer – on the contrary, there is a decrease that positively affects the growth and ripening of crops. According to observations of M. Habrylovych, at the air temperature of 20°C on a summer day, the soil temperature reaches 24.4°C, and the temperature of the bedding is – 23.8°C [8]. Reduction of temperature takes place because tree crowns retard sunlight; also, leaves of trees and herbaceous plants absorb heat [7]. Due to warming of the top of the crowns, evaporation processes increase that leads to decreasing the temperature.

## CONCLUSIONS

Kherson region is characterized by intensive use of land resources, mainly in agriculture, that has conditioned a number of negative trends in the agricultural sector such as erosion, deflation, reduction of crop productivity, and so on. Forest lacy blown shelterbelts are a good method of agro reclamation; they reduce wind speed, contribute to even distribution of snow cover on the fields, lower rates of erosion and soil blowing, have a

positive impact on crop yields. Unfortunately, at present, only 12–15% of shelterbelts in Kherson region are preserved in a good condition and able to perform such functions. Other field protecting forest plantations are neglected or completely destroyed [5].

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