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DOI <https://doi.org/10.30525/978-9934-26-238-8-15>

**THE INFLUENCE OF THE MESOCLIMATE CHANGE  
OF THE WESTERN UKRAINIAN BROAD-LEAVED FOREST  
ZONE ON THE YIELD OF WINTER CEREALS**

**ВПЛИВ ЗМІНИ МЕЗОКЛІМАТУ ЗАХІДНОУКРАЇНСЬКОЇ  
ШИРОКОЛИСТЯНО-ЛІСОВОЇ ЗОНИ НА ВРОЖАЙНІСТЬ  
ОЗИМИХ ЗЕРНОВИХ КУЛЬТУР**

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Climatic conditions are a determining factor in shaping the productivity of agricultural crops. We are observing trends in changing weather and climate conditions, the main manifestation of which are significant

temperature drops, uneven precipitation, and an increase in the number of natural phenomena in recent years [1; 3; 7; 8]. These processes require in-depth study and scientific evaluation in each specific area. It is important to study the influence of mesoclimate changes on the growth, development and formation of crop yields, in particular, winter wheat and barley. They occupy a leading place in the structure of cultivated areas of the Western Forest Steppe [2].

An important prerequisite for the adaptation of winter grain crops to specific soil and climatic conditions is favorable thermal and moisture resources [8]. Assessment of the complex influence of air temperature and precipitation on the productivity of winter wheat and barley during the last decades gave important results. Changes in meteorological indicators during the growing season were generally favorable for the cultivation of winter cereals in the forest-steppe zone. We can obtain the productivity of this crop at the level of 88 to 93 % of the economic maximum yield in the new conditions [1]. Research materials [2; 8] from the study of the influence of meteorological factors on the productivity indicators of grain crops in different regions of Ukraine testify that in the western regions from 1992 to 2014 there was a significant increase in the productivity of these crops. In particular, the average yield increased from 2.6 to 4.3 t/ha. It is also related to the intensification of cultivation technologies and the use of an adaptive farming system [6].

Long-term observations of weather conditions confirm various manifestations of meteorological phenomena during one calendar or vegetation year, and even more so during several years and even decades [4]. The climate is gradually becoming warmer and wetter [5; 9]. This leads to catastrophic consequences in some regions. Such trends lead to the improvement of growing conditions for the main agricultural crops, including winter cereals, in certain areas, in particular, in the European part of the world. The increase in temperature is mainly due to the winter period. This allows plants to support the life processes of winter crops during this period and even go through certain stages of their ontogenesis. As a rule, we observe more precipitation in the cold season. Torrential rains became more frequent in the first half of summer. They are accompanied by strong winds and sometimes hail. This leads to crop damage, first of all, to the laying of winter crops [8].

The second half of the spring period was characterized by dryness and high temperatures 10 years ago. The situation has gradually changed in the fields of the Western Ukrainian broad-leaved forest zone in recent years. For the most part, a sufficient amount of precipitation and a moderate

temperature regime make it possible to successfully increase the vegetative mass of even weakened plants of winter grain crops during April-May. Such a situation arises when sowing was carried out after odd-numbered predecessors in late periods. Winter crops can develop root systems and survive short periods without rain. We observe such droughts for at least 10–15 days every year [3].

The weather and climate conditions in Ukraine and in the western region have changed significantly compared to the average long-term indicators in the direction of warming, led to the review of traditional and the search for new approaches in the technologies of growing winter grain crops.

According to our observations, the average annual air temperature was 9.0 °C in 2016–2020 against 8.6 °C in the period 2001–2015 in Pasmove Pobuzhzhya of the Western Ukrainian Broad-Leaved Forest zone. The frost-free period averaged 165 days and slightly increased. 2019 was very warm, however, the driest. 2018 was distinguished by optimal warmth and balanced humidity. We distinguished relatively favorable and unfavorable years – dry and overmoistened years, with significant temperature fluctuations. 2016, 2018 and 2020 were wet, 2016 was excessively wet. The average maximum air temperature increased by 0.4 °C, but by 1.6 °C relative to the climatic norm. The average annual precipitation fluctuates around 569 mm with a tendency to aridization of the landscape.

We performed experiments with the rates of mineral fertilizers for winter barley and stabilized the accumulation of nitrates with nitrapyrin, a urease inhibitor. The action of nitrapyrin and the effectiveness of nitrogen fertilizers depended on the favorable weather conditions of the autumn and spring-summer vegetation of winter barley.

In general, the warming in Ukraine intensifies in the direction from south to north and exceeds the climatic norm by 1 °C on average in the northern regions [8; 9]. According to forecasters, an increase in the average annual temperature by 1 °C shifts the border of each of the agrarian climatic zones by an average of 100 km to the north. There are conclusions of meteorologists that the temperature has already increased by 2 °C in certain zones. Therefore, the boundary of climatic zones, probably, shifted by almost 200 km [8].

Analysis of the dependence of the productivity of agricultural ecosystems under the influence of climatic factors showed that the amount of precipitation affects the yield of winter crops during May and June (close relationship  $r = 0.8$ ). The reserves of productive moisture in April and May are similarly affected (correlation coefficient  $r = 0.8$  and  $0.9$ ) [1]. We forecast the estimated maximum yield of wheat in May and June (4.0 t/ha

and 4.24 t/ha) with rainfall of 100 mm and 110 mm, respectively. The maximum yield will be approximately 4.6 t/ha and 5.0 t/ha, respectively, if the forecast reserves of productive moisture in April are 44 mm and in May 32 mm.

So, during the last decades, some changes in the mesoclimate occurred in the conditions of the Western Ukrainian broad-leaved forest zone, which led to an increase in the yield of grain crops, in particular, winter wheat and barley. The combined influence of heat and moisture in the modern mesoclimate is favorable for the formation of a high yield of winter crops during the autumn growing season, increases and reaches a high positive level during the period of vegetation recovery, but slightly decreases under unfavorable weather conditions during the period of grain formation and ripening.

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