CHANGES IN AGROMETEOROLOGICAL CONDITIONS OF THE AUTUMN PERIOD IN THE SOUTH OF UKRAINE

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Climate change has made adjustments to the rather complicated and ambiguous issue of sowing winter crops, which is one of the main factors of the technological process, which significantly affects the production processes and the formation of the harvest. Since 2001, there has been a significant change in the temperature regime of the autumn growing season of winter crops. Thus, on average, in 1971–1990, during the autumn period, the sum of average daily air temperatures was 498 °C, and in 2001–2005 it reached 608 °C, in 2006–2010 – 689 °C, in 2011–2015 – 720 °C, and in 2016–2020 – 718 °C, or by 110, 191, 222 and 220 °C more, respectively (Table 1).

Table 1. Changes in temperature regime and duration of the autumn vegetation period of winter wheat by years (data from the regional centre for hydrometeorology, Kherson)

Indicator	Value	Years				
		1971–1990	2001–2005	2006–2010	2011–2015	2016–2020
Sum of average daily temperatures, ºC	actual	498	608	689	720	718
	±	-	+110	+191	+222	+220
Average daily air temperature, ºC	actual	8,1	8,6	9,6	9,9	9,5
	±	-	+0,5	+1,5	+1,8	+1,4
Duration of autumn vegetation, days	actual	63	71	73	78	76
	±	-	+8	+10	+15	+13

During these periods, the average daily air temperature also increased by 0,5–1,8°C and the duration of the autumn vegetation period by 8–15 days.

During 2013–2019, in most cases, longer and warmer periods of autumn vegetation of winter crops were also observed. From July to the end of September 2014 and 2018, as well as from mid-October 2015, 2017 and 2019, extremely difficult agrometeorological conditions characterized by prolonged air conditions were observed in the pre-sowing period of winter crops in southern Ukraine. Vegetation irrigation of soybean crops as a precursor to winter crops was completed in the first to third decade of August. To ensure friendly germination and the required level of moisture, pre-sowing irrigation was carried

out at a rate of 500 m³/ha in 2014, post-sowing irrigation (450 m³/ha) in 2015, and pre-sowing (500 m³/ha) and seedling-inducing irrigation (250 m³/ha) in 2017.

In 2013 and 2016, no pre-sowing irrigation was required, as there was sufficient rainfall in September to ensure friendly germination: 43,7 mm in 2013 and 33,2 mm in 2016. The pre-sowing and germination irrigation carried out in 2015 and 2017, as well as precipitation against the background of high temperatures in November, contributed to the improvement of winter crops. In October-November 2015 and 2017, 62,8 and 52,6 mm of precipitation fell, which was 98 and 82% of the long-term average for this period. In addition, the average monthly temperature in September and November 2015 was 4,5 and 2,9 °C above the long-term average, and in September-October 2017 it was 3,5, 1,5 and 1,0 °C above the long-term average.

In autumn 2016, the temperature was 1,6°C higher in September alone, and 1,4°C and 0,4°C lower in October and November. In the autumn of 2018 and 2019, before sowing winter crops, the productive moisture reserves in the sowing layer of the soil were only 6–8 mm, which was not enough to get friendly germination. Therefore, in 2018 and 2019, pre-sowing irrigation was carried out at a rate of 400 and 500 m³/ha, respectively. In general, autumn 2019, as well as 2018, was characterized by elevated temperatures, which were 2,1 and 2,3 °C higher than the long-term average. The amount of precipitation in autumn 2019 was 113 mm (109% of the seasonal norm), and in 2018 – 84 mm (81% of the norm). The amount of precipitation that fell during the period ‘sowing – end of autumn vegetation’ varied significantly during the years of research and ranged from 4,3–63,9 mm in 2013, 27,9–87,0 mm in 2014, 57,2–65,3 mm in 2015, 23,7–98,0 mm in 2016, 93,3–96,0 mm in 2017, 6,1–22,1 mm in 2018 and 60,8–131,2 mm in 2019.

Wet conditions were observed in 2016, when from 20 September, 1, 10 and 20 October until the end of the growing season, precipitation was 42,1 mm, 56,0 mm, 28,9 mm and 0,7 mm higher than the average for the period 1945–2010, respectively. In 2013, 2015, 2017 and 2018, the amount of precipitation during all sowing periods was below normal. At the same time, in 2013, the largest precipitation shortfall was observed during sowing on 20 October (-39.7 mm), and in 2015, 2017 and 2018, the largest precipitation deficits were observed during sowing on 20 September and 1 October: 50,7 and 36,7 mm, 36,3 and 23,0 mm, 31,5 and 30,0 mm, respectively.

In 2019, the precipitation during the autumn growing season when sowing on 20 September and 1 October exceeded the norm by 16,2 mm and 18,1 mm, respectively, and when sowing on 10 and 20 October was less than the norm by 26,2 mm and 21,2 mm. In 2014, the amount of precipitation for sowing on 20 September and 10 October was 20,2 mm and 3,2 mm above normal, while for sowing on 1 and 20 October it was 6,8 mm and 5,9 mm below normal. Thus, there have been significant changes in agrometeorological conditions and a noticeable warming trend.