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AGROMETEOROLOGICAL CONDITIONS EFFECT ON WINTER WHEAT GROWTH AND DEVELOPMENT

The paper considers key aspects of the issue of lems of assessing agrometeorological conditions effect on the growth and development of winter wheat that aim grounding the conducted research; it also analyzes the effects of an unprecedented rapid process of climate change on the crop growing.

Keywords: climate, greenhouse effect, global warming, human-induced warming, agro-climatic conditions, heat, moisture amount, sum of active temperatures,frost-free period, average temperature, weather, Selyaninov hydrothermal coefficient (SHC).

Topicality.

According to preliminary estimations of national experts, the global warming will undoubtedly can have serious implications for agriculture, in particular, affect the composition of major crops productivity.

Due to the expected increase in air temperature in North semisphere food safety in Ukraine will largely depend on the efficiency of agriculture adaptability to the expected climate change, future agro-climatic conditions for crops growing. Therefore, the problem of assessing the impact of the expected climate change on agro-climatic conditions of growth, productivity and gross grain harvest of winter wheat - which is the basic cereals in Ukraine - is very important.

Analysis of the latest literature data shows that different scenarios of changes in the global climate are possible in next century. It is believed that the climate change that have begun will cause changes in weather conditions and precipitation areas in the new century. It is assumed that rainfall amount will increase slightly in the steppe zone [1].

The average annual air temperature change will definitely cause billions losses in agriculture. Even a 1^0 C fall will reduce the growing season by at least two weeks. The above mentioned scenarios of possible global climate changes in 2030, in any form is confirmed in a number of publications. The research [2] supposes increase in global temperatures in 2030 within 0,5-2^0 C .

M. Budyko [3] considers 2,5-3,5^0 C increase in global temperatures most likely to happen by 2050 compared to 1970. A trend of precipitation increase, especially in warm months is evident.

By the 2025-2030 ΣR will increase by 165 mm. As a result, the conventional plants hydration and moisture supply (SCC, MD, Yef/E0) will increase within Ukraine, the amount of precipitation (ΣR) is expected to increase as well as conventional humidity parameters (CHP, Md) and plants moisture supplyf (Yef/E0). By 2030 they will increase by 45-55%, 40-50% and 15-20% relative to the climatic norm (CN).

The expected outcomes will change into the ones favorable for agricultural production by 2010-2030. Radiation-thermal resources, will not fall low enough to change the existing allocation scheme of crops zonal species composition fundamentally. Changes are possible at the varietal level only.

Winters will become milder, which will benefit winter crops hibernation. This will expand the area of land for winter wheat, winter barley, maize and soybean cultivation.

Water resources will increase significantly, moisture conditions will be sufficient for most crops. Under following the cultivation technologies crops yields increase by 20-30% in 2030 can be expected in the steppe zone.

A.Polyovyi, N. Kulbida et al. [4] of winter learned to predict winter wheat productivity in 2030-2040 in Ukraine grounding on agro-climatic conditions of the cultivation.

The research aims at theoretical and practical generalizing and solving an important problem of assessing the impact of climate and agrometeorological conditions changes on winter wheat growth and development.

Research Methodology. The study was conducted in 2011-2013, in a stationary field experiment at the experimental field of Bila Tserkva NAU. Quantitative and qualitative comparison method as well as abstract-logical and analytical methods were used in the research.

Results and discussion. In the central forest steppe of Ukraine plants growth, development and yield formation are influenced mostly by the heat, precipitations number and nature.

Метеорологічні умови 2010-2011 сільськогосподарського року (листопад – жовтень). Рік у цілому був сприятливим для вирощування пшениці озимої. Найхолоднішим місяцем за цей період був лютий 2011 р. із середньою місячною температурою повітря мінус 6,2 (рис. 1).

The climate in the zone is temperate continental, distinguished with sufficient heat and moderate moisture. Sum of active temperatures during the study was within 2762,5-3134,9^0 C . The period with an average temperature above 150 ° C was 110 days, frost-free period lasted 170 days on average. The average air temperature was about 8.50^0 C.

Meteorological conditions in agricultural year 2010-2011 (November - October). On the whole the year was favorable for growing winter wheat. The coldest month in this period was in February 2011 with an average monthly air temperature 6.2 below zero.

The lowest temperature recorded was 22.0 below zero in February.

The warmest month was July, the average temperature of which was 21.6^0. The highest temperature(above34^0) was observed in July.

The average temperature of the warm period (April-October 2011) was defined 0,5-$1,10^0$ above the standard.

Warmth availability in the growing season in 2011 was higher than average long-term indices, but lower than in the previous year.

Precipitation during the agricultural year were distributed unevenly. Most of them fell in July 2011 - 164mm (230% of monthly norm); the least - in March 2011 - 10mm (30% of the monthly rate).

Precipitation amount during the cold season was close to average yearly and was 89-113% of the norm.

Precipitation amount during the warm season was close or slightly larger than the average yearly and was 96-120%.

Selyaninov hydrothermal coefficient (SHC) value for the period May-September amounted to 1,6-2,2 (overly-wet conditions).

At the end of September 2010 winter wheat sown at the optimum time shot. Productive moisture reserves were adequate and optimal. In November, the weather was very warm and wet that contributed productive moisture replenishment and promoted wheat growth and development. November 26 was the date of the crops growing season termination, which was almost a month later than the average long-term date. Winter wheat tillered and embedded well. The density amounted to 370-610 plants per 1 m^2. Each tiller plant formed 1,8-2,7 stem.

Agrometeorological conditions for wintering were mainly satisfactory from the cessation growth till the end of February. Winter wheat was in dormancy. The minimum soil temperature at depth of tillering node did not fall below 7-11^0 C. Mass vegetation occurred in late March in the terms close to the average long-term.

Based on the results of the spring survey sowing density formed within 365-570 plants per 1 m^2, tillering was 2-3 stems per plant. In late April the winter wheat stems growing started, the formation of straw lower node was observed, ear formation and ears laying lasted until the end of May.

In late May, against the background of hot and dry weather winter wheat ear formation finished , grain formation and ripening began. Sowing density in the phase of mass earring was 500-1110 productive stems per 1 m^2. Productive moisture reserves at the end of May were poor and were 5-11 mm in the plow layer and 46-48 mm in a meter layer.

Grain formation and ripening took place in the first half of June, against a background of hot and dry weather. Dry winds and soil drought caused grain premature drying and its weight reduce.

Productivity indices before harvesting also depended on the studied varieties, cultivation technology, and fertilizing standards and researched predecessor.

Meteorological conditions of agricultural year 2011-2012 were marked with shorter winter period (2-3 weeks) than the usual one and with a long summer (a month and a half longer) and was generally favorable for winter wheat growing.

The coldest month was February 2012 with an average monthly air temperature below 11^0 C.

The lowest temperature was also recorded in February, it was32^0 C.

The warmest month was July, the average temperature of the moth made $22,9^0$. The highest temperature was observed in August – above 38^0.

The average temperature of the cold period (November 2011 - March 2012) was 2.5^0 lower than the norm. The average temperature of the warm period (April - October 2012) was 0.7^0 higher than normal.

Warmth availability in the growing season in 2012 was 505^0 higher inthan the average long-term indices of the past 5 years. Precipitation during the agricultural year were distributed unevenly. Most of them fell in August 2012 - 123 mm (181% of monthly rate), and the lowest amount in November 2011 - 4 mm (9% of monthly rate).

During the cold season precipitation amount was close to normal 78-100%. During the warm season precipitation amount was also close to normal - 76-104%.

Selyaninov hydrothermal coefficient (SHC) for the period May - September was 1.0-1.1 (insufficient moisture).

In 2011-2012 efect of agrometeorological conditions on growing winter wheat were as follows. In the autumn of 2011 there were unfavorable conditions for wheat sowing and autumn growing. Warm, sunny and dry weather contributed moisture evaporation from the soil surface. Therefore, during the planting productive moisture reserves were insufficient.

Mass of shoots of winter wheat in all the studied areas formed in early October. In the second decade of October established cool for this time of year wet weather. The rains occuring at the end of the first and in the second decade of October, significantly replenished stocks of productive moisture in the soil.

In October 15 there was a steady shift of average daily temperature to 5^0 C downward, winter crops ceased active growing season two weeks earlier than average long.

From October 1 until growing cease the amount of effective air temperatures above 5^0 C was only $70\text{-}95^0$ C. On some days when the maximum temperature raised to $5\text{-}12^0$ C, the plants vegetated slowly, but due to the small number of effective heat the growth processes were inconspicuous.

During November and December wheat was at dormancy. Only on some days when the daily temperature increased to $6\text{-}13^0$ C, winter wheat vegetated slowly. By December 1 winter wheat, despite optimal moisture reserves, managed to deploy only the third leave, only occasionally 1.5-2.0 stems formed.

Winter weather regime established only at the end of the first decade of January, which was 1-1.5 months later than the average long lasting periods - soil froze and stable snowpack was established. Very cold weather, which dominated from late January to mid-February, when the minimum temperature reduced to $20\text{-}32^0$ C below zero was safe for winter crops due to a uniform 36 cm layer of snow. Minimum soil temperature at depth of tillering node didn't fall below $5\text{-}9^0$ C.

In the second decade of March very warm weather contributed to snow rapid melting. Winter wheat growing season resumed in the second half of March at the time close to the average long-term.

During the first decade of April in plants that overwintered unbushed, rooting and tillering began, which lasted until the end of the month. Productive moisture reserves for winter wheat by April 8 were optimal: 43 mm in the arable soil and 61 mm in a meter layer.

According to the results of the spring survey of winter wheat the sowing density was formed within 360-510 plants per 1 m^2 under 1,5-2,3 stems per plant bushing.

In late April winter wheat showed straw lower node: stem growth began to lay the germ ears. Conditions for the formation of productive ear were favorable. Total number of spikelets in the ear was 16-18.

In May the weather was very warm with torrential rains short, growth of intensive growth of warmth continued. Under these conditions the temperature rapid development of winter balls occurred.

By May 21 earring was observed which was 1-2 weeks earlier than the average long periods. The density of winter was wheat formed on the rate 570-900 productive stems per 1 m^2.

In early June the grain in the ear reached normal size 2 and grain milk ripeness was recorded-3 weeks earlier than the average long periods. 26-42 grains were formed in one ear. The plant height was 63-101 cm.

The results of determining winter wheat productivity before harvesting depending on the varietal traits were as follows: productive stems number per 1 m^2 and 1000 grains weight at standard grain moisture (14%) was respectively - 480-1200 and 38-48 g, the number of grains in an ear was 28-42.

Agrometeorological characteristics of 2012-2013 winter wheat cultivation. 2012 -2013 agricultural year was warm and rather humid and generally favorable for winter wheat growing. Major abnormalities were observed in the rainfall distribution.

Record-breaking rainfall In September had surpassed the maximum monthly rainfall rate for the entire period.

The coldest month was in December 2012 with an average monthly air temperature -5.10 C.

The lowest temperature was recorded also in December, it was 23^0 below zero.

The warmest month was June, the average temperature amounted to 23.4^0, which is 30 higher than normal.

The highest temperature was observed in June and August - above 33^0.

The average temperature of the cold period (November 2012-March 2013) was close to the normal (last year it was 0.4^0 below the normal).

The average temperature of the warm period (April - October 2013) was 1.2^0higher than the normal.

Shoots formed in late September - early October. In October the weather was unstable with precipitation. The average daily temperature was higher than the normal at most days of the month by $4\text{-}8^0$ C, and on some days it was $1\text{-}3^0$C lower than the normal. Such weather conditions contributed to the active development of crops.

By of October 29, stocks of productive moisture in the plow layer soil were sufficient and optimal and made 36-40 mm. Stocks of productive moisture meter soil layer at the end of the growing season were 128% of the norm.

Within a month the winter wheat tilled and rooted. 1,4-3,0 stem formed on one plant.

In November the weather was warmer than usual than usual with rainfalls. The average daily temperature was higher than the normal at most days of the month by 4-11^0 C. The maximum temperature in the warmest days increased to +15-16^0 C.

From November 14 (two weeks after the average long terms) growth cessation occurred. The crops tilled and rooted well.

The density was 310-460 plants per 1 m2, 2-3 stems formed on a plant. Winter weather regime established by December 4-5. The winter was characterized by relatively warm weather with intense precipitation, snow cover and insignificant soil freezing.

Winter wheat restarted growing in the first half of April, which is 2-3 weeks later than the average long-term.

According to the results of the spring examination, the winter wheat sowing density was formed within 300-440 plants per 1 m^2 under tilling of 2-3 stems on the same plant.

From the second decade of April there began intensive increase of heat at the end of the month and since the beginning of the growing season the amount of effective air temperatures above 5^0 C was 157-186^0 C (the average - 125-145^0 C).

A very warm weather with short rains was Most days of May and heat increased. Under these temperature conditions rapid development of winter crops occurred. By May 20 heading in winter wheat was observed 1-2 weeks earlier than the average long-term.

In early June the winter wheat grains reached the normal size grain milk ripeness was recorded, 2-3 weeks earlier. formed 38-40 grains formed in one ear.

Забезпеченість теплом вегетаційного періоду 2013 року виявилася вищою на 320^0 за середні багаторічні показники, але на 183^0 нижчою ніж у минулому році (табл.1).

The results of winter wheat productivity determination were as follows: the number of productive stems per 1 m^2 was 510-1010; grain weight of 1 m^2 - 674-1100; 1000 grains weight under standard humidity was 38-48 g.

Warmth availability of 2013 growing season was 320^0 higher in than the average long-term performance, but 183^0 lower than in the previous year (Table 1).

Table 1 - The sum of effective temperatures

Year	**Σ 5^0**	**Σ 10^0**
2011	2273	1349
2012	2595	1555
2013	2410	1385

Precipitation during the agricultural year were distributed unevenly, there was . - 139mm (269% of monthly rate) in September 2013, and the lowest was in October 2013 - 13mm (33% of monthly rate).

The amount of precipitations was twice the norm in the cold season -184% , the amount for the warm period close to the norm - 105%.

Таблиця 2 – **Кількість опадів за холодний та теплий періоди (фактична та у % до норми)**

Year	**Cold period (November – March)**		**Warm period (April – October)**	
	actual, mm	**% of the rate**	**actual, mm**	**% of the rate**
2011	182	92	500	126
2012	151	77	446	113
2013	362	184	416	105

The amount of HTC in May-June was 1,3 -1,5 (moisture).

Conclusions:

1. Agriculture is affected by unfavorable meteorological conditions more than any other branch of economics. The caused loss make about 65%. They can be reduced under reasonable applying methods and practices which eliminate the negative impact of unfavorable meteorological conditions on agriculture facilities.

2. The weather and climate affect crops productivity significantly. Thus, estimating the level of weather favorability during the growing season to form the crops productivity is an urgent task.

3. Creating and accumulating nutrients in plants depend upon soil and climatic conditions, growing technologies and reasonable choice of crop rotation.