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Risks of plant growing in conditions of North-East Steppe in connection with climate fluctuation

Hromiak V.,
Nalyvaiko V.

The purpose. To duly adjust approaches to plant growing depending on climate fluctuations in conditions of concrete region. **Methods.** Scientific theoretical and empirical: comparisons, analysis and synthesis (for assessment of influence of change of weather environment upon growth and development of field crops), content-analysis (at clustering data on climate fluctuation), axiomatics (for calculations of the conjecture of changes in development of crops), mathematical data processing (for detection of trends of changes of rainfall amount for the certain periods). **Results.** The problem of influence of climate fluctuation on risks of plant growing in regional conditions is considered. Concerning climate fluctuations forecasts of domestic scientists are compared to actual trends on the basis of the given local meteorological stations. Assessment of vulnerability of basic groups of field crops to climate fluctuations in conditions of North-East Steppe is given. **Conclusions.** For prevention of possible risks in branch of plant growing in connection with climate fluctuation it is necessary within the limits of regional programs of acclimatization to these changes to develop scientific approaches to some production operations and elements of techniques.

Key words: climate fluctuation, plant growing, Steppe of Ukraine, acclimatization of plant growing.

Formulation of the problem. Climate change in the past few decades in Ukraine is very substantial [3], frequency close to the average long-term values of meteorological elements and their transition dates quantities at regular gradation does not exceed 10% of the total number of years. Therefore, there is reason to believe that in this period the traditional orientation of the plant growing on the average long-term weather information (climatic norm) in most years is ineffective. [13] The risks associated with climate change, explain the vulnerability (lack of readiness) and inclination (people or assets of harm) in combination with hazards. Each of these three components can be the goal for reasonable action to reduce risk [18]. As far as mankind has not learned how to control climate, it is necessary to scientifically adapt crops to climate change. Inactivity on solving the problems of climate change, delaying the adaptation will lead to a loss of 5-20% of GDP per year [8]. Given that climate changes manifest differently in different regions, have a different speed, scale and sometimes even opposite direction [5], timely adjustments of approaches to crop production depending on the climate in a particular region is very important. This question is relevant to the north-eastern steppe of Ukraine.

Analysis of recent research and publications of the subject.

Climate change in Ukraine at the turn of 20-21 centuries and possible scenarios of its further transformation till 2050 are well covered in the works of local scientists as Balabuh V.O., Voloshchuk V.M., Dmitrenko V.P., Adamenko T.I. ., Shevchenko O.G. and other [1,3,7,20]. Works based on the material published by the International Panel on Climate Change (IPCC), meteorological data bases, mathematical models of prediction different scenarios of human development. Conclusions as for impact of climate change on various areas of life and nature are almost clear. Regarding the impact of climate change on the agricultural sector, and specifically, on very important sub - crop, conclusions should be divided into two groups. Some of them are related to the actual changes that have occurred; others have the nature of the forecast. The researchers observe that global warming in Ukraine over the past decade, complies with global trends and led to:

- significant changes of the thermal regime (increase of average, maximum and minimum, annual air temperatures, and therefore increase the amount of active and effective temperatures); For example, in the northeast of the territory of Ukraine climatological in winter (1961-1990) standard norm of isotherm (- 6 ° C), and for the period 1991-2010 there is isotherm (-4 °); [11]
- regime change of moisture (rain reallocation of the season compared to the climate norm and change of their number);
- frequency of extreme and hazardous weather phenomena (increase of the number and intensity of natural disasters: droughts, heat waves, heavy rains, heavy snowfall, ice, etc.);

- regime change of wind (direction of the wind, the more powerful influence of the Atlantic Ocean and the Mediterranean Sea) [2,9].

As for crop, these changes have increased the length of the growing season, improving conditions for wintering of winter crop, increased volatility during the vegetation period [1], increased infection of crops plant pathogenic fungi, expanding the range of pathogens [10], greater dependence yields of anomalies (spring frosts and droughts).

Number of heat waves (period of abnormally hot weather when the temperature during 5 days increases climate norm at 5° Celsium) per decade in eastern Ukraine has grown over the past century from 0 to 11 (Table 1) [20].

Table 1. The number of cases of heat waves in eastern Ukraine for decades, quantity.[20]

1911-1920	1921-1930	1931-1940	1941-1950	1951-1960	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010
0	4	4	3	5	2	4	1	6	11

The number of days with temperatures above 30 ° Celsium increased. During the summer in areas of the Luhansk region there are 17-26 days in average [19].

Regarding further forecasts of future climate change in the northeastern Ukraine steppe conditions scientists point to the direct dependence on scenario which will occur greenhouse gases in the world. IPCC has offered 40 scenarios covering a wide range of potential greenhouse gas emissions, combined in 4 groups according to four possible options for changing the situation in the future [4]. But all the scenarios envisage growth of air temperature in the future for Ukraine (although the magnitude of change is different for different forecast model) and change in rainfall during the year. Thus, one of the projects [20] by

2030, compared with the period 1990-2010 years, it is expected: growth of temperature (Table 2); change in average monthly rainfall amounts (Table. 2); offset climatic seasons; change the length of the growing season; increase in frequency and intensity of heat waves; changing the balance between precipitation of solid and liquid precipitation; reduce the length of the occurrence of permanent snow cover, changes in relative humidity; increase in frequency and intensity of natural display of meteorological phenomena; changing local water runoff.

Table 2. Projection of monthly average temperature changes (° C) and average monthly rainfall amounts (%) 2030 in Ukraine and East of Ukraine(according to specialists of National State Hydrometeorological Institute [3])

Region	Month												Year
	1	2	3	4	5	6	7	8	9	10	11	12	
The projection of average temperature changes (°C)													
East	0,30	0,06	-0,30	0,36	0,45	0,84	0,69	0,52	0,50	0,49	0,79	1,28	0,50
Ukraine	0,20	0,0	-0,20	0,28	0,39	0,64	0,62	0,59	0,67	0,50	0,57	1,04	0,44
The projection change in average monthly precipitation amounts (%)													
East	22	9	17	21	-1	16	8	-13	42	1	8	12	12
Ukraine	17	5	17	21	4	6	-1	-12	7	-7	9	13	7

Most researchers believe that XXI century will be a period of unprecedented rapid climate change, promises unpredictable weather conditions and a distinct regional character, and the warming will accelerate the process of desertification and increase the frequency of droughts in some regions [12.18].

Agricultural science has already developed some recommendations for growing field crops in the Luhansk region based on analysis of climate experiments. Thus, scientists of LNAU determined that over the past decade conditions winter wheat growing season in the Luhansk region deteriorated to 9-13%, but still satisfactory judging by Dmytrenko classification coefficients of performance, there is a downward trend in crop yields; sowing of winter crops moved two weeks later deadlines. Scientists of Experiment Luhansk Station defined agro-climatic optimum term of sowing of winter crops in eastern Ukraine - from 20 September to 5 October. An appraisal climate for growing districts of Donbass winter wheat, sunflower, grain sorghum [6,14].

Scientists have proposed to shift the terms of sowing of winter wheat due to higher temperatures in autumn, lack of moisture and the development of certain types of sucking insects; the main squares in the fields occupied with plant varieties which are recommend by regional state centers examination of plant varieties; introduce the culture and selection of new, related traditional, but are more resistant to changing conditions and culture; adapted by selection of indicators that are relevant [7, 10,17].

Materials and methods. Meteorological data meteorological observations served as materials for analysis c. Luhansk during 1838 - 2013, forecasts of foreign and domestic scientists on climate change in the north-eastern steppe Ukraine. We used methods of comparison, analysis and synthesis, content analysis, axioms, mathematical processing.

The purpose of the article - based on analysis of climate change indicators in terms of north-eastern steppe Ukraine over the past decade, scientific forecasting literature data on climate change in the region, to identify the risks of doing crop, adjust crop approaches to overcome the negative effects of climate change.

Results. The main climatic elements for the crop are temperature and precipitation. These factors largely determine the timing of agricultural operations and the level of productivity. Temperature change in conditions of northeastern steppe of Ukraine over the past decade compared to the climate norm for the entire observation period (175 years) is shown in Table 3.

Table 3. Average monthly temperature for meteorological Lugansk,˚ C [15]

Month												Per
1	2	3	4	5	6	7	8	9	10	11	12	year
During the entire observation period (175 years)												
-6,5	-5,8	-0,1	8,9	16,0	19,9	22,3	21,1	15,1	8,2	1,8	-3,5	8,1
During the 1994-2013 years(20 years)												
-4,3	-3,6	1,9	10,3	16,7	20,8	23,4	22,0	15,5	9,1	3,0	-2,0	9,4
The difference (20-year period to 175 years)												
+2,2	+2,2	+2,0	+1,4	+0,7	+0,9	+1,1	+0,9	+0,4	+0,9	+1,2	+1,5	+1,3

As you can see, over the past two decades weather has become much warmer (+ 1,3° C). In this case, the average temperature rose in all months of the year, but during the cold months the difference between long-term climate norm and current data more significant (Figure 1).

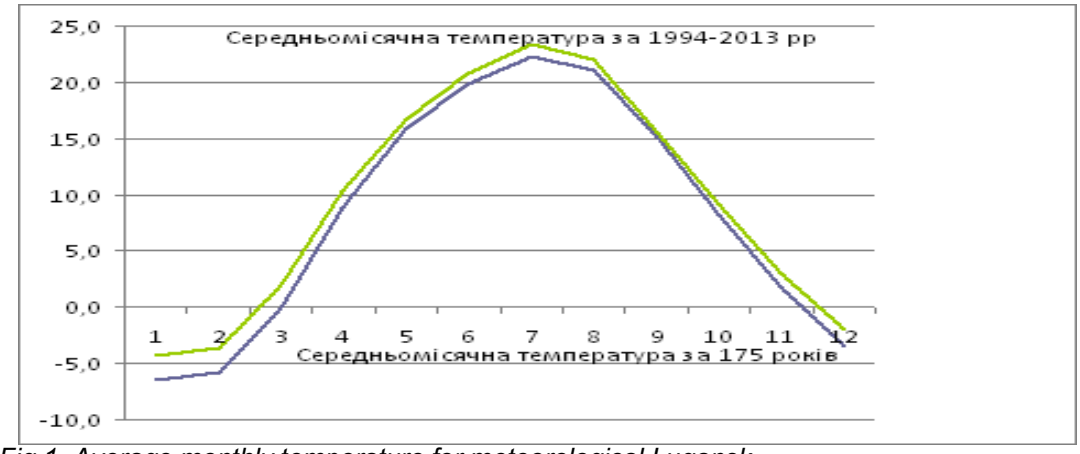

Fig.1. Average monthly temperature for meteorological Lugansk

Large temperature fluctuations during the year reflect still sufficient continental climate, but tend to decrease due to the growing influence of the Atlantic Ocean and the Mediterranean, especially in winter. In the summer heat waves and droughts become more frequent and longer.

Excess temperature (ballast temperature) according to the observations of scientists and agronomists-practitioners result in suspended animation of individual cultures and lengthening of the growing season.

Anxiety is caused by dynamic growth temperatures at the regional level, though small, over the last decade in May ($\hat{y} = 0.3497x + 15.3467$) R^2=0,2, when a critical period comes in relation to the moisture in most of early spring crops, which determines the level of productivity. In August, when preparing the ground for sowing of winter crops is hold and the created conditions of getting guaranteed stairs, high temperatures are hardly change in the future ($\hat{y} = -0.0145x + 22.94$), R^2=0,0006 (Figure 2) against the background of the projected decrease in rainfall.

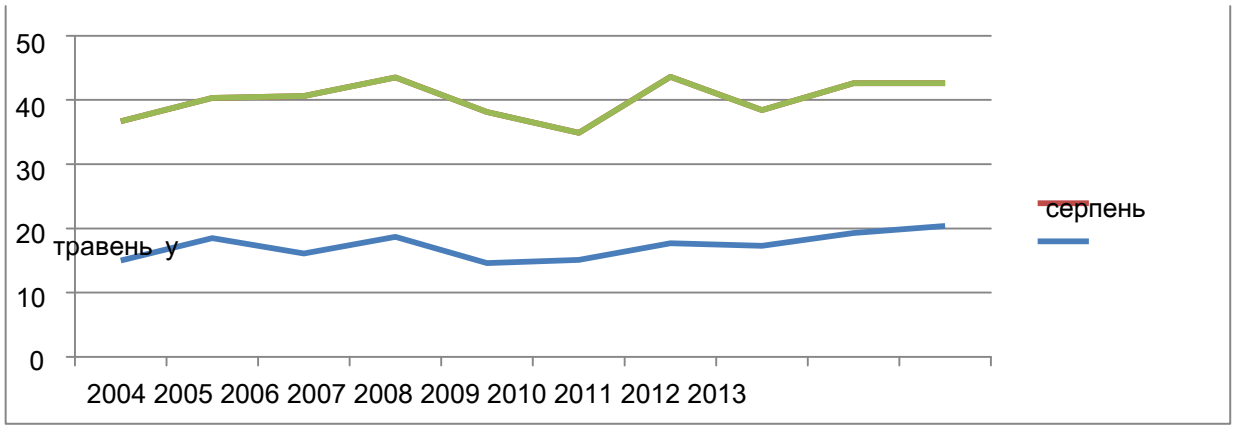

Figure 2. Dynamics of average temperatures in the course of May and August for 2004-2013

Significant adjustments during the growing season of crops bring freezing, intensity and probability of which depend on the physical and geographical conditions of the area. In the humble field intensity frosts can be greater at 2-5 ° C. The first autumn frost in the ground begins in the third week of September (average date), and the last - in the spring (in the second week of May). The period without frost varies in the Luhansk region from 129 to 143 days [19]. Notably regional climate changes that emerged in recent decades:

- september frost, which a couple of decades ago caused significant damage practically disappeared, limited cultivation of medium hybrid corn and other late crops;
- late May frosts occur much less frequently;
- sometimes spring a general warming observed cold wave of significant intensity frost (to -5 ° C), which were recorded at higher than before the background temperature that increases their negative impact on crops.
- cold frost wave of significant intensity (до -5°C) happen sometimes with general warming climate, which were observed at a higher than before the background temperature that increases their negative impact on crops.

The amount of active temperatures during the growing season has increased in 173˚ C (Table 4), the largest growth was recorded in the spring.

Table 4. The amount of active temperatures (> 10˚C) during the growing season in Luhansk weather station,˚ C

Years, period	Month						During the growing season
	april	may	june	july	august	september	
1838 - 2013	84	496	597	691	654	453	2875
1994-2013	134	518	624	725	682	465	3148
Difference	+50	+22	+27	+34	+28	+12	+173

Also the amount of effective temperature significantly increased (the temperature at which a certain culture vegetates, limit zone for most species is 5˚ C) (Table 5).

Table 5. Amounts effective temperatures (> 5˚ C) during the growing season in Luhansk weather station,˚ C

Years, period	Month							During the growing season
	4	5	6	7	8	9	10	
1838 - 2013	117	341	447	536	499	303	99	2342
1994-2013	159	363	474	570	527	315	127	2535
Difference	+42	+22	+27	+34	+28	+12	+28	+193

For the latest period which is analyzed, total precipitation during the year significantly changed (Table 6). Drops are much more - now an average of 503 mm, but as it got warmer the stronger evaporation is. Most precipitation falls on the warm period in the form of showers, but with increased temperature and the need of plants in the moisture also increases.

Over the past 30 years value hydrothermal coefficient of Selyaninova (SCC) increased to 1.0 in Luhansk, to 1.2 - in Troitsky; continental climate gradually reduced by reducing the amplitude of seasonal course of surface temperature.

The number of days of drought in the air in Luhansk region is 51. Relative humidity of the air in the summer months is 64-70% in average over the last 20 years. Very often drought is in May (10 days - long-term value). [19]

Table 6. The rainfall in meteorological Luhansk, mm.

Month												Per
1	2	3	4	5	6	7	8	9	10	11	12	
During the entire observation period (175 years)												
25	22	26	32	44	56	53	40	32	33	34	30	427
During the period of 1994-2013 years (20 years)												
35,9	35,4	36,6	32,9	40,9	61,9	55,7	34,3	47,2	44,1	36,8	41,5	502,8
The difference (20-year period to 175 years)												
+10,9	+13,4	+10,6	+0,9	-3,1	+5,9	+2,7	-5,7	+15,2	+11,1	+2,8	+11,5	+75,8

More rains fall in late autumn period, winter and early spring, there is an accumulation of moisture. Peak rainfall during last 20 years, still falls in June, in some years, June and July are reversed (during last 10 years June was leading 6 times(678 mm), July - 4 times (547 mm)). Despite the significant increase in precipitation that falls during the year, in some months (May and August) their marked reduction in comparison with the period of observation during 175 years (Figure 3).

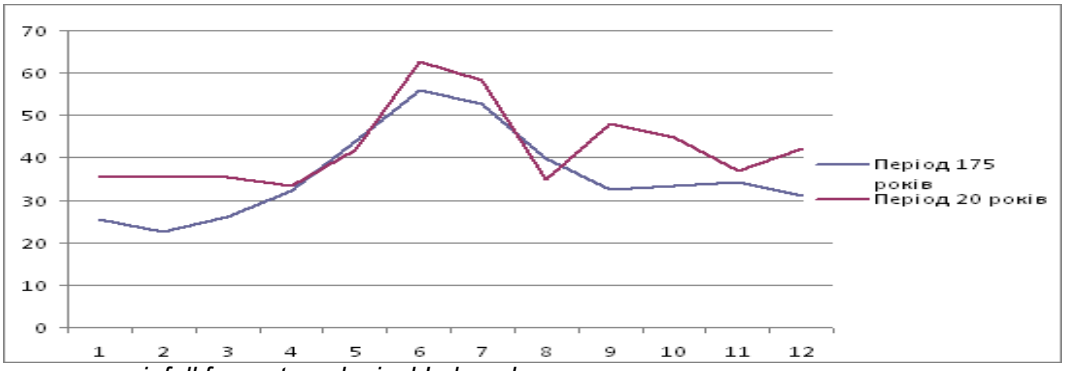

Figure 3. The average rainfall for meteorological Luhansk, mm

It is important to know the tendency of changes in amount of precipitations for plant growth and development in critical months. Statistical analysis of the data for the last 10 years which is shown in May ($\hat{y} = 1.3212x + 35.7333$), R2=0,02, and in august ($\hat{y} = 1.2182x + 15$), R2=0,01rainfall amount tends to increase, and vice versa, in June ($\hat{y} = -5.4303x + 97.6667$), R2=0,11, and in July ($\hat{y} = -3.5333x + 74.1333$),R2=0,19, to reduction.

The general tendency as for number annual precipitation in Luhansk weather station for the last 10 years has negative ($\hat{y} = -18.6788x + 588.3333$),

R^2=0,3, that is peak of increasing amount of precipitations has passed (Figure 4)

Fig.4.Amount rainfall in Luhansk weather station for the period 2004-2013

The number and intensity of natural disasters increased: drought, hot winds, heavy rains, strong winds, heavy snow, ice and so on.

A similar pattern of climate change over the past 30 years is in all five agro- climatic districts (tab. 7).

An important feature of the modern climate of the region, which is manifested in all seasons, was sharp differences of daily air temperature within 10-15 ° C for 1-2 days, fluctuations in rainfall. Sudden weather changes are accompanied by all kinds of dangerous weather and natural phenomena.

Table 7. The main climate indicators agro-climatic regions of Luhansk region for the years 1983-2013 [19]

Number of district	Meteorological station	Sum of temperature higher 10°C	Total precipitation during year, mm	The number of days of drought in the air	Hydrothermal coefficient
1	Troitske	2920	542	27	1,2
2	Bilovods'k	2929	536	43	0,9
3	Svatove	2992	555	36	1,0
4	Luhansk	3148	528	45	1,0
5	Darivka	3017	617	33	1,1

Influence of the Atlantic and the Mediterranean climate in Ukraine increased, but in the Luhansk region that impact among regions of Ukraine is the least. It provides a soft warm winter. Summarize how the climate will change in the region by 2030, according to forecasts of Ukrainian National State Hydrometeorological Institute, the positive and negative points. (Table 8)

Table 8. Assessing the impact of the expected climate change on crop production in the northeast steppe of Ukraine in the short (2030) perspective

The manifestations of climate change	Positive points	Negative aspects
The increase of annual air temperature in 0,5 ° C Increase amount of precipitations over the year in 12%	Probability of critical soil temperature for wintering of winter crops and perennial grasses in winter drops to 4-10%	It will not be provided with full vernalization of winter crops. More active decomposition of humus in the soil; worse moistening the soil. More favorable conditions will be wintering pests, plant pathogens, weeds.
Shifting climatic seasons	Sowing of spring crops will be earlier, time of work will be extensed	-
Changing the duration of the growing season	You can grow more late-ripening cultivars practice nutritious crops	-
Increase frequency and intensity of heat waves	-	State plants will worsen and level of productivity will decrease
Changing the balance between precipitation of solid and liquid precipitation	The probability of spring water erosion is reduced	-
Reducing the duration of the occurrence of steady snow cover	-	The worst winter conditions for winter crop

Changing the relative humidity of air	-	The deterioration of pollination, yield reduction
Increase of frequency and intensity of natural display of meteorological phenomena	-	The threat of destruction of plants by spring frosts, rain, hail will be saved
Changing local water runoff	-	Reserves of fresh water for irrigation will be reduced to 40%

Note that most forecasts of climate change are confirmed by dynamics of factual data of regional weather stations. But there are some regional features in climate change, there has been a tendency which does not contradict common features, but deeply revealing their identity. Thus, our data:

- the total annual rainfall will not increase by 12%, on the contrary, the peak growth rainfall has already passed and there is a tendency to reduce it;
- rainfall amount by months and years vary greatly, July and June can be peaks of precipitation;
- lately there are two peaks of heat in the warm season - May and August;
- anomalous heat registers increasingly when the vegetation stops, it falls into suspended animation;
- september frost disappeared;
- spring is becoming early, but prolonged with possible return of cold fronts.

That is why crop adaptation to climate change should be carried out taking into account the regional features.

What adaptation crop should go through to be damaged less by climate change, let's deal with the types of crops what are approximately similar in developmental biology (tab. 9) using evaluation form vulnerability applied [20] for cities, but with other indicators.

Table 9. Vulnerability assessment of major groups of field crops to climate change in terms of north-eastern steppe of Ukraine

Indicator	Vulnerability assessment, point		
	Early spring crops	Late spring crops	Winter crops
Rising temperatures during the cold period	0	0	0
Rising temperatures during the warm period	1	2	1
Peak heat in August	0	2	0
Additional heat peak in May	2	1	1
Increase (decrease) of total precipitation during the year	1	2	1
The decrease precipitation in May	2	1	2
The decrease precipitation in August	0	1	2
Return cold air waves in spring	1	1	0
The increase warm waves in the warm season	2	2	2
Increase of frequency and intensity of natural display of hydrometeorological phenomena	2	2	2
Shifting climatic seasons	0	0	0
The decrease of duration of the occurrence of steady snow cover	0	0	2
Changing the balance between precipitation of solid and liquid precipitation	0	0	1
Changing the relative humidity	1	1	1
Total points	12	15	15

The evaluation scale has three points: 0 - not relevant 1 - important 2 - very important. Common culture in the region - spring barley, oats, peas we refer to the early spring crops; millet, buckwheat, corn, sunflower (suspended), sorghum, melons - to late spring crops; wheat, corn - до to winter crops.

There are cultures that occupy small areas which are risky for cultivation (winter rape, spring wheat and some other) they need separate detailed analysis.

All cultures grown in the northeastern steppe of Ukraine are vulnerable to climate change but most vulnerable are winter and late spring crops. Work on the study of adaptability and feasibility of growing crops to climate change must continue on a number of crops - peas, winter rape, buckwheat, spring wheat, and the possibility of growing chickpeas, soybeans, oilseed flax, medium and late groups ripening corn, pumpkins, and others. For early spring grain crops (spring barley, spring wheat, oats) conditions can deteriorate due to increasing aridity of important periods of vegetation of this group of plants which will take place with higher temperature background in comparison to current. With the constant moisture conditions it may cause decreasing yields of spring grain due to reducing the growing season and earlier maturation [16]. In our view you must also change the technological elements adapting them to climate change (Table 10). It will reduce losses, and obtains more stable yields.

What steps, technological methods should be implemented in plant growing to withstand the negative effects of climate better and maximize the advantages - these issues must be solved today.

It should be noted that the climate change happening to the overall reduction of soil (humus content reduction, battery, erosion) it greatly impairs their physical properties and potential resistance to adverse conditions. Therefore, along with the introduction of element technologies aimed at the prevention of adverse weather conditions should improve soil fertility and prevent their erosion.

Table 10. Direction of technological methods in crop depending on changes of climatic factors in terms of north-eastern steppe of Ukraine

The fact of climate change indicators	Direction in regional technological methods
Significant deviations in temperature and precipitation from long-term climatic norm. Variability of 1. Adamenko T.I Bez panIki: klImatichnI zmIni mozhut viyavitisya korisnimi dlya sIlskogo gospodarstva, odnak voni takozh mozhut zagrozhuvati ymovIrnim opustelyuvannyam chastini ukraYinskoYi teritorIYi. «UkraYinskiy tizhden» # 29 (246), 2012.- S.4-7. 2. Adamenko, T. Perspektivyi ukrainskogo zernovogo ryinka v kontekste globalnogo potepleniya // Hranenie i pererabotka zerna. – 2008. – # 6. – S. 28-32. 3. Balabuh V.A. Mezhgodovaya izmenchivost intensivnosti konvektsii v Ukraine // Globalnyie i regionalnyie izmeneniya klimata; pod red. Osadchego V.I. / V.A. Balabuh. – K.: Nika-Tsentr, 2011. – S. 161-173. 4. Balabuh V.O. RegIonalnI proyavi globalnoYi zmIni klImatu v Zakarpatskly oblastI/V.O. Balabuh // UkraYinskiy gIdrometeorologIchniy zhurnal: Naukoviy zhurnal. – Odesa: Vid-vo PP «TES», 2013. – # 13. – S.55-62. 5. Balabuh V.O.RegIonalnI proyavi globalnoYi zmIni klImatu v TernopIlskly oblastI ta mozhlivI Yih zmIni do seredini HHI st. FIzichna geografIya NaukovI zapiski. #1. 2014. S 43-54 6. Baranovskiy O.V., Trofimenko M.M., Vecherov V.I., Shumska G.M., Mitroshin A.M. AgroekologIchne obGruntuvannya dotsIlnostI viroschuvannya zernovogo sorgo v posushlivih umovah LuganskoYi oblastI. AgroekologIchniy zhurnal, # 3.- 2013.-s.65-69. 7. Vozhegova R.A.Zroshuvane zemlerobstvo v umovah optimIzatsIYi zemlekoristuvannya stepovoYi zoni UkraYini.- MIzhvIdomchiy tematichniy naukoviy zbIrnik “Zemlerobstvo” - Vipusk 85.- 2013. S 44-51. 8. Doklad MGEIK: Izmenyayuschiysya klimat porozhdaet shiroko rasprostranennyie riski, odnako suschestvuyut vozmozhnosti dlya effektivnyih otvetnyih mer. MGEIK 2014/11/PR.- Yokogama, Yaponiya .- 2014.- 3 s. 9. Izmenenie klimata v Vostochnoy Evrope Doklad ZoYi environment network (Zheneva, Shveytsariya) v sotrudnichestve s YuNEP / GRID-Arendal (Norvegiya) i initsiativoy «Okruzhayuschaya sreda i bezopasnost» (ENVSEC) pri uchastii organizatsiy i spetsialistov Belarusi, Moldovyi i Ukrainyi. «GRAPHI 4», Bresson (Grenobl), Frantsiya.- 2011.- 60 s.	Critical attitude to long-term climate predictions, more focus on regional data. Create automatic active meteopost for getting climate information with a grid to 10 km for reliable modeling, adjustment of technology. The navigation more on regional, adapted to local conditions varieties. Sow mostly recommended by regional state centers of expertise varieties of plants varieties and hybrids.

10. Kirichenko V.V., Tsehmeystruk M.G., Ryabchun N.I. Ogurtsov Yu.E. Stan I perspektivi rozvitku sIlskogo gospodarstva HarkIvschini v umovah zmIni klImatu. VIsnik Tsentru naukovogo zabezpechennya APV HarkIvskoYi oblastI.-HarkIv, 2011.- S.10-26. 11. Krakovska S.V. ChiselnI proektslYi klImatichnih zmIn v Luganskly oblastI do 2050 roku. Nauk. pratsI UkrNDGMI, 2011, Vip. 261.-S. 37-55. 12. Kokorin A. O. Izmenenie klimata: obzor pyatogo otsenochnogo doklada MGEIK. Fizicheskaya nauchnaya osnova. Vozdeystvie na prirodu i cheloveka. Smyagchenie izmeneniy klimata. Poligraf Media Grupp. Vsemirnyiy fond dikoy prirodyi (WWF) Moskva.- 82 s. 13. Paptsov A.G.Adaptatsiya selskogo hozyaystva Rossii k globalnyim izmeneniyam klimata. VNIIESH, 2014.-44 s 14. Popyitchenko, L. M. Pogodno-klimaticheskie usloviya vegetatsii ozimoy pshenitsyi v Luganskoy oblasti / ZbIrnik naukovih prats Luganskogo natsIonalnogo agrarnogo unIversitetu Lugansk : [Vid-vo LNAU].- #100. - 2009.S .121-124. 15. Sokolov I.D., Dolgih E.D., Sokolova E.I., Mostovoy O.A. Osnovnyie klimaticheskie pokazateli vostoka Ukrainyi (po dannyim Luganskoy meteostantsii).- g. Lugansk, izdatelstvo LNAU.- 2009 g. 24 s. 16. Strategicheskiy prognoz izmeneniy klimata RF na period 2010-2015 gg i ih vliyaniya na otrasli ekonomiki Rossii. Rosgidromet.M.-2005.-30 s. 17. Trofimenko L. T., Korshunova N. N., Aristova L. N. Vliyanie izmeneniy klimata na razvitie rastenievodstva v Voronezhskoy oblasti. Trudyi VNIIGMI-MTsD. Vyipusk 178.-2014 S.14-21. 18. Hideki Kamanaru. Prodovolstvennaya bezopasnost v usloviyah izmeneniya klimata. Byulleten VMO 58(3),- iyul 2009 g.-S.205-209. 19. Usatenko Yu.I.KlImatichnI osoblivostI reglonu.- Lugansk.-LGDS,-2012.-7s. 20. Shevchenko O.G. ta In. OtsInka vrazlivostI do zmIni klImatu: UkraYina. KlImatichniy forum shIdnogo partnerstva (KFSP) ta Robocha grupa gromadskih organIzatsIy zI zmIni klImatu (RG NUO ZK), 2014.-61 s. climate characteristics leads to increasing likelihood of extreme adverse events. The unpredictability of the climate. Significant influence on regional weather microrelief.	
Rainfall prevails evaporation in late-fall, winter and early spring periods, but some of them can be counterproductive. With proper agrotechnics moisture reserves in the soil almost annually renewed before the early spring sowing to the average, even after bad predecessors.	Provide in the technologies operations of moisture accumulation in these periods and prevent runoff of melting (Chiseling, digging, plowing across the slope, the remains of stubble, sometimes snow keeping). Take into account that in winter there is a washing mode of nitrogen reduced role and the role of autumn-early spring fertilizing of winter crops increased. Plan anti-erosion measures cultivation and accumulation of organic carbon in the soil.
Increasing the amount of flow of active and effective temperatures and consequently lengthening of the growing season for 5-10 days	Calculate within the administrative areas the opportunity of sowing more recent by dates ripening groups of ripeness of individual crops, under favorable conditions, crop sowing plan opportunity, cultures. Adjust by districts optimal terms of sowing of winter crops, depending on the needs of plants in the heat, earlier sow early spring crops. To prevent overheating of the soil regulate its temperature by mulch and the optimal frequency of plants
Not very distinct May peak heat appeared in addition to August peak. Recorded as the days with low humidity	Adjust vegetation of crops sowing time, groups ripening varieties of plants so that the peak heat did not match the critical phase of the culture in need to moisture. Focusing on varieties of winter crops with a short autumn period of development. During the growth of vegetables, fruits, plants,
Warmer winters with displays of anomalies, lack of stable snow cover.	Weigh risks wintering of winter crops. To study the possible winter in phase awl. View the seeding rates due to lack of full vernalization

Increasing amounts of rainfall and temperature led to changes in the number of generations of pests harmfulness periods, the best of their winter, diversity and spread of diseases	Plan constant monitoring of crops, appropriate measures in technologies
Short periods of abnormal temperature in the warm season increasingly recorded	During the calculations of harvest terms take into account possible period anabiosis of plants
In fact, early-autumn frosts disappeared, and the number of late spring declined with a negative trend returning at a higher temperature background	You can cautionary plan growing more late varieties and hybrids of agricultural crops

Conclusions

To prevent possible risks of crop due to climate change, within the regional programs of adaptation to these changes it is necessary to create automatic meteorological centers, improve scientific approaches to manufacturing certain technological operations and elements of the technology.

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