

METEOROLOGICAL AND AGROMETEOROLOGICAL WEATHER CHARACTERIZATION OF SUMMER DROUGHT OF 2015, IN THE REPUBLIC OF MOLDOVA

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Abstract. The summer of 2015 in the Republic of Moldova was dry, with significant negative consequences for agriculture. The analysis of drought conditions was conducted through soil moisture reserves (first 100 cm), monthly amounts of precipitation, monthly average temperatures, hydrothermal coefficient Seleaninov, etc. In conclusion, it is stated that the territory of the Republic of Moldova is not an exception to global climate change and every year the drought affects intensively the agriculture of the republic, and there were proposed solutions to adapt to the new climate conditions.

Agriculture plays an important role in the economy of Moldova, especially regarding the employment and the expanding of exports. During the recent years, the agriculture has contributed to an average of about 12-14% of the country GDP and over 30 percent of the active rural population is engaged in agriculture. The fertile soils and annual rainfall offer generally favourable conditions, creating opportunities for the development of agriculture, which contributes significantly to the economic growth and food security of the country.

However, the intensity and frequency of natural hazards, such as droughts, floods, hail and frost have increased significantly in the past few years, having a negative impact on agricultural development. Moldova is prone to natural hazards because of a specific combination of geographical location, climate change and inadequate soil cultivation practices.

The summer of 2015 in the Republic of Moldova was very hot with deficient rainfall. The average air temperature in Moldova for this season was +21,6 ...

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+23,8°C, being 2,2-3,3°C higher than the norm, which is recorded in average once in 15-30 years in the whole period of observation and in the last 20 years - an average of once in 5-7 years. The maximum air temperature throughout the season climbed to +38,3°C (August, MS- Meteorological Station, Kamenka), signaling in the country on average once in 5-10 years during the entire period of observation, and in the last 20 years – on average once in 2-3 years. The minimum air temperature dropped to +7°C (June, Codrii MS).

The number of days with maximum temperature $\geq + 30^{\circ}\text{C}$ air on the territory during the season was 36-55 days, the norm being 8-27 days, which is recorded in average once in 15-20 years. The number of days with air temperature $\geq + 35^{\circ}\text{C}$ was on territory about 8-21 days, the norm being 1-2 days, which is recorded in average once in 15-25 years.

In August was reported an abnormal hot weather with deficient rainfall. The average monthly temperature of the air was higher compared to the normal values by 2,5-4,3°C, which in August was recorded on average once in 15-30 years. The number of days with maximum air temperature $\geq + 30^{\circ}\text{C}$ was on the territory 20-23 days (the month norm being 3-11 days), which is recorded on average once in 15-30 years, and isolated on other territories (Briceni, Soroca, Cornești, Dubasari) was recorded in August for the first time during the entire period of observation. The number of days with maximum temperature $\geq + 35^{\circ}\text{C}$ air was 3-9 days on the territory (the monthly norm being one day), which is recorded on average once in 10-20 years.

The quantity of rainfall during the summer on 60% of the territory was 80-160 mm (40-70% of the norm). On some territories in the Northern and Central districts of the country fell only 50-70 mm (20-30% of the norm), which on these areas was reported for the first time in the entire period of observation or on average once in 25-30 years. Just MS Falesti, Comrat and AMP (Agrometeoro-logical Post) Basarabasca rainfall was close to the norm and was 145-150 mm.

During the summer season in the country were reported thunderstorms, fog, hail having the diameter up to 10-15 mm (MS Briceni, Vulcanesti AMP) and strong wind up to 22 m/ s (June, MS Tiraspol). Also there was reported adverse climatic risk in the form of strong showers: on June 15 at WFP, Drochia during three hours fell over 51 mm of rainfall; on June 16 at MS Codrii during one hour fell 31 mm; on June 25th in MS Fălești during four hours fell 52 mm of rainfall; on July 9 at MS Bravicea during three hours fell over 59 mm of precipitations. Heavy rains fallen during June and the first decade of July, isolatedly accompanied by hail, damaged crops and caused material damages for the national economy.

Compared to the 2014 summer season it was warmer (1,5-2,5°C) and with less rainfall (with 50-150 mm). The same happened in 2007 and 2012, when it was reported higher air temperature and less precipitations.

Abnormally warm weather and significant rainfall deficit, was observed in Moldova in most of the summer which contributed to pedological and atmospheric drought.

The hydrothermal coefficient from June averaged 0,7, which indicates dry conditions in July and August, HTC averaged 0,5, which corresponds to a severe drought.

Due to the dry weather, which was reported in the most summer season, it had negative influence on the yield formation of maize, sunflower, sugar beet, also on the development and growth of vegetables and other crops.

During June the weather over the country's territory was generally good for the growth, development and yield formation crops. However, in some districts, was reported a deficiency of rainfall, due to the insufficient moisture reserves in the soil, there were less favorable conditions for further growth and development of crops.

In the first half of June was reported grain ripening in milk, and in the second part of June - grain ripening in wax. There was reported full ripeness in some parts of the country at the end of June some farms started harvesting. Generally, the conditions of harvesting were favorable. On June 28, 2015, the productive humidity reserves in the plowed soil layer having the thickness of 1 m on the fields with winter crops on 55% of the territory constituted 60-110 mm (75-125% of the norm), on the rest of the territory it was 15- 50 mm (20-70% of the norm).

During the same month the growth of maize leaves continued and at the end of the month the 13th and the 17th leaves appeared. On some territories early sowing began tasseling. At the end of June the plant height was 80-180 cm. On June 28, 2015 the productive humidity reserves in the soil layer having thickness of 0,5 m on fields with maize on 55% of the territory constituted 45-60 mm (75-110% of the norm), on the rest of the territory it was 10 -30 mm (20-50% of the norm), the soil layer with the thickness of 1 m it was 75-135 mm (75-120% of the norm), on some other territories - 50-65 mm (45-60% of the norm). It was reported that in the first half of the month began the sunflower leaf formation. In the second half of the month was reported the inflorescence formation and at the end of the month it began flourishing. At the end of June, the plant height was about 90-155 cm. On June 28, the productive humidity reserves in the soil layer thickness of 0,5 m on fields with sunflowers was 5-35 mm (10-60% of the norm), on other territories – 50-60 mm (80 -120% of the norm), in the soil layer having the thickness of 1 m it was about 30-70 mm (45-70% of the norm), on other territories it was about 75-115 mm (80-110% of the norm). The main root of sugar beet continued thickening and it was reported full coverage of spaces between rows. In orchards continued the growth of fruit of cherry, and early varieties of apricots and peaches. It was also reported the ripening and harvesting. The berries of vine plants continued to

grow. On June 28, the productive moisture reserves in the soil layer having thickness of 1 m on 60% on fields with multiannual plantations constituted 65-105 mm (75-85% of the norm), isolated on other territories it was about 10-60 mm (10-50% of the norm).

Due to the dry weather maintained during the most part of July, there were created favorable conditions for the formation of the harvest of maize, sunflower, sugar beet, also for the growth and development of vegetables and other agricultural crops.

In the first half of July, in terms close to the ordinary ones, agricultural farms in the Republic of Moldova started harvesting the autumn crops and the spring cereals. At the end of the month the majority of farms completed their work. In July was reported the appearance of male (tassel) and female inflorescences (husks) and their blossoming. At the end of the month the maize started baking in milk (1 to 2 weeks earlier than the usual terms). The height of the plants at the end of the month was about 155-220 cm, isolated on some territories it was about 125-140 cm. Each plant having about 1-2 husks.

On July 28, 2015, the reserves of productive moisture in the ground with a thickness of 0,5 m in the fields with maize was low and was about 10-30 mm (20-50% of the norm), isolated on other territories – 35-45 mm (75-90 % of the norm) in the soil with a thickness of 1m it was about 25-65mm (25-70% of the norm), isolated, on other territories it was 85-95mm (95-100 % of the norm). In July was reported the blooming of sun flowers, at the end of the same month on some territories began the first seed ripening (10-20 days earlier of the ordinary terms). The height of the plants at the end of the month was about 125-175 cm. The capitula diameter was about 14-21 cm. On July 28 the reserves of productive moisture in the ground with a thickness of 1 m on fields with sunflower seeds was low and constituted 10-65 mm (15-60 % of the norm). The heavy rains which fell on 30-31 July completed the reserves of productive moisture in the top layer of the soil and improved a little the conditions for the growing and development of agricultural crops on the largest part of the territory of the country.

Because of the dry and droughty weather conditions which lasted the whole August there were created unfavorable conditions for the harvest of maize, sunflower, sugar beets, and also for the growth and development of vegetable crops and other agricultural crops. The high temperatures and the deficiency of precipitation contributed to the drying of the top layer of soil, creating unfavorable conditions for preparing land for sowing autumn crops.

During the same month the maize began to ripen into milk and wax. By the end of the month on some territories it was fully ripened. On August 28, 2015 the reserves of productive moisture in the ground with a thickness of 1 m on fields covered with maize was low and constituted 15-60 mm (15-65 % of the norm). To

sunflower seeds during the course of a month continued to ripen, at the end of the month it reached full maturity and some farms in the southern part of the country started harvesting. On August 28, 2015, the productive humidity reserves in fields with sunflowers having soil layer with thickness of 1 m were low and were 5-50 mm (5-45% of the time). The main root of sugar beet continued thickening. There continued to ripen the plums, apples, pears and grapes. Most farms started collecting fruit and early varieties of grapes crops. On August 28, 2015, the productive humidity reserves in the soil layer with thickness of 1 m on areas with multiannual crops was low and was generally 15-60 mm (25-65% of the norm).

According to the information of the Ministry of Agriculture and Food Industry the average crop of autumn wheat in the Republic of Moldova in 2015 was 2,9 t/ha, of autumn barley – 2,5 t/ha, of spring barley – 2,2 t/ha, of colza- 1,8 t/ha and of peas – 1,5 t/ha. In the Northern part of the country, in Briceni, Edinet, Riscani, Falesti, Floresti districts, and also in Comrat, there was registered an average productivity of wheat (more than 3,2 t/ha.). A lower productivity was registered in Strășeni, Telenești districts as well as in Chișinău and Nisporeni district. (1,5 – 2,0 t/ha). There were obtained better results in harvesting autumn barley in the Northern part of the republic, in Drochia – 3,2 t/ha, Briceni, Edineț and Florești – 3,0 t/ha while in the central part of the country recorded the lowest productivity, whose average was 2,1 t/ha. At the same time, better results at harvesting spring barley were registered in the Central part of the country having an average productivity of 2,6 t/ha.

So, in 2015, the total volume of winter crops harvest was 970 thousand tons, including wheat – about 830 000 tons (<http://www.maia.gov.md>).

In **conclusion**, we can mention that the drought of 2015 confirms once more the low level of adaptation of the agriculture of the Republic of Moldova to conditions with rainfall deficit which more frequently and with greater intensity affects the agrarian sector in the last years. In order to reduce the heavy burden of agricultural producers in the country we propose a series of measures to mitigate and adapt agriculture to climate change, including drought:

1. Continuous restoring and development of the areas of irrigation:
 - a) The revitalization of available irrigation systems;
 - b) Enlarging the irrigable areas with dripping irrigation, especially for the multiannual plants;
 - c) Implementing the methods of underground irrigation in order to rationally use the aquatic limited resources;
 - d) Increasing the number of water reservoirs to collect surface water;
 - e) Simplifying the mechanism of farmers access to groundwater for irrigation.

2. Approving and implementing of varieties and hybrids of agricultural crops, including the native ones, with a high genetic resistance to drought, adapted to the climatic conditions of the Republic of Moldova;

3. Intensifying investigations related to the selection and improvement of crops resistant to drought; subsidizing the production sector and multiplying seed and planting material of superior biological categories.

4. Implementing the advanced agricultural systems of plant cultivation: sustainable agriculture, organic farming, precision agriculture, conservative agriculture, including the No-till and Mini-till technologies;

5. Respecting the optimal nutritional doses for plants, extensive use of organic fertilizers, using the foliar treatment of plants with microelements and complex nutraceuticals, including biologically active substances (auxins, gibberellins, cytokinins, abscisic acid, etc.) that lead to the optimization of water regime cultivars and more effective metabolism of water resources;

6. Strengthening the process of consolidation of agricultural parceled land, implementing organic agricultural crop rotations, compliance placement of crops on land with hilly relief, applying procedures for combating soil erosion;

7. Applying the integrated plant protection, timely treatment against the diseases and the pests of plants, weed control, which reduces the water from soil;

8. Creating forest housing, planting protection strips, respecting the special status of protection of natural areas protected by the state (scientific reserves, natural landscapes, resources etc.);

9. The extension of fundamental scientific research in genetics, molecular biology, physiology, biochemistry, biophysics etc. regarding the elucidation of the mechanisms of plant adaptation to water stress and developing the technological methods to mitigate its consequences on the growth processes, the development and fructification of crop plants;

10. Raising the technical endowment of the agricultural sector; developing the post-harvest infrastructure, especially, the collection and storage of agricultural products;

11. Strengthening the national institutional system of management of agricultural risks;

12. Improving the methodology of assessing the impact of natural disasters on the agricultural sector;

13. Preparing qualified specialists and scientific staff in irrigable agriculture which is a specific direction in the agricultural sector, that requires a distinct approach.

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