

Climate change and Moldova's agriculture



Изменения климата и полеводство Молдовы

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The flow of meteo parameters in Moldova(1945-2007)

Parameters	temperature, (t°C)	rainfall, mm
annual; average	+9,32	530
Flow	+7,68....+12,1	250,3...768,1
winter; average	-2,21	99
Flow	-8,6...+2,02	30,8....246,6
spring; average	+9,29	122,6
Flow	+6,72...+11,8	47,2...214,7
summer; average	+20,26	207,1
Flow	+18,3...+23,1	87,1...341,0
autumn; average	+9,39	119,2
Flow	+8,3...+11,69	49,2...216,5

Amount of rainfall

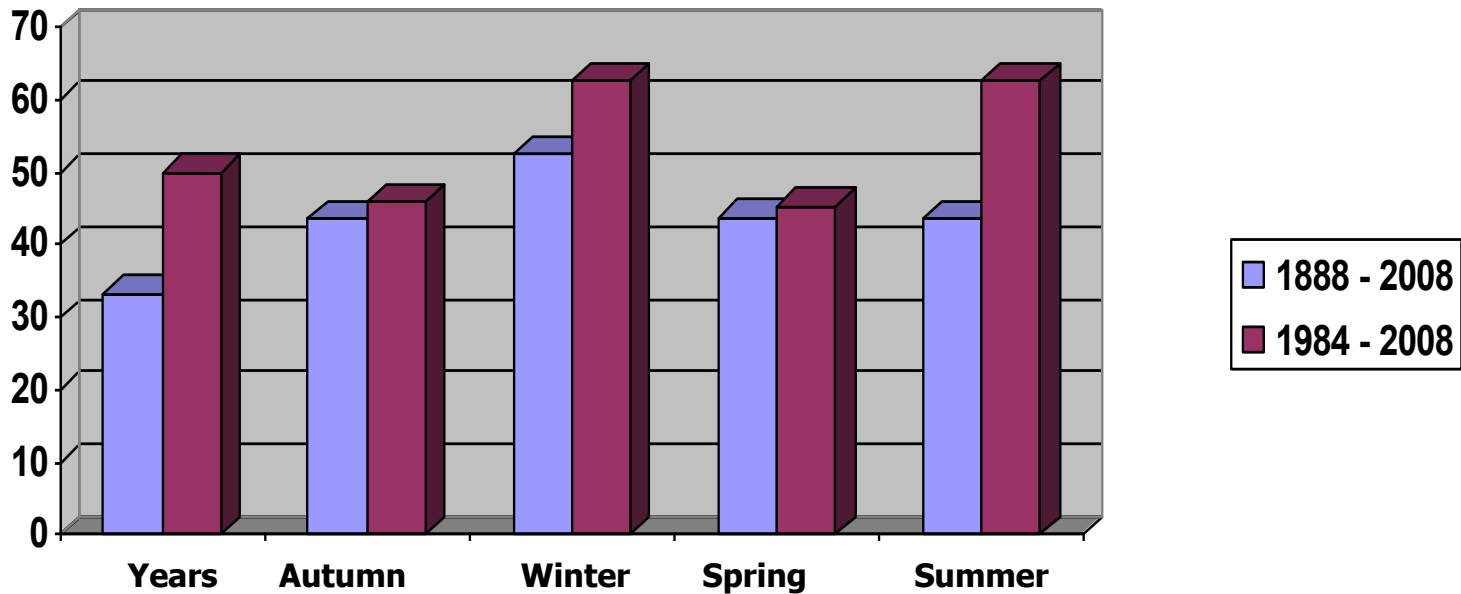
(Chişinău, Moldova, 1853 - 2007)

	<= 290 mm	291-390 mm	Very dry years, mm	391-444m m	All dry years	445-600 mm	> 600 mm
1) 1853 - 1941 (92 years)							
:years	3	25	28	20	48	44	7
:%	3,3	27,2	30,4	21,7	52,2	47,8	7,6
2) 1945 - 2007 (62 years)							
:years	2	2	4	8	12	31	19
:%	3,2	3,2	6,5	12,9	19,3	50	30,6
3) 1853 - 2007 (154 years)							
:years	5	27	32	28	60	75	26
:%	3,2	17,5	20,8	18,2	39	48,7	16,9

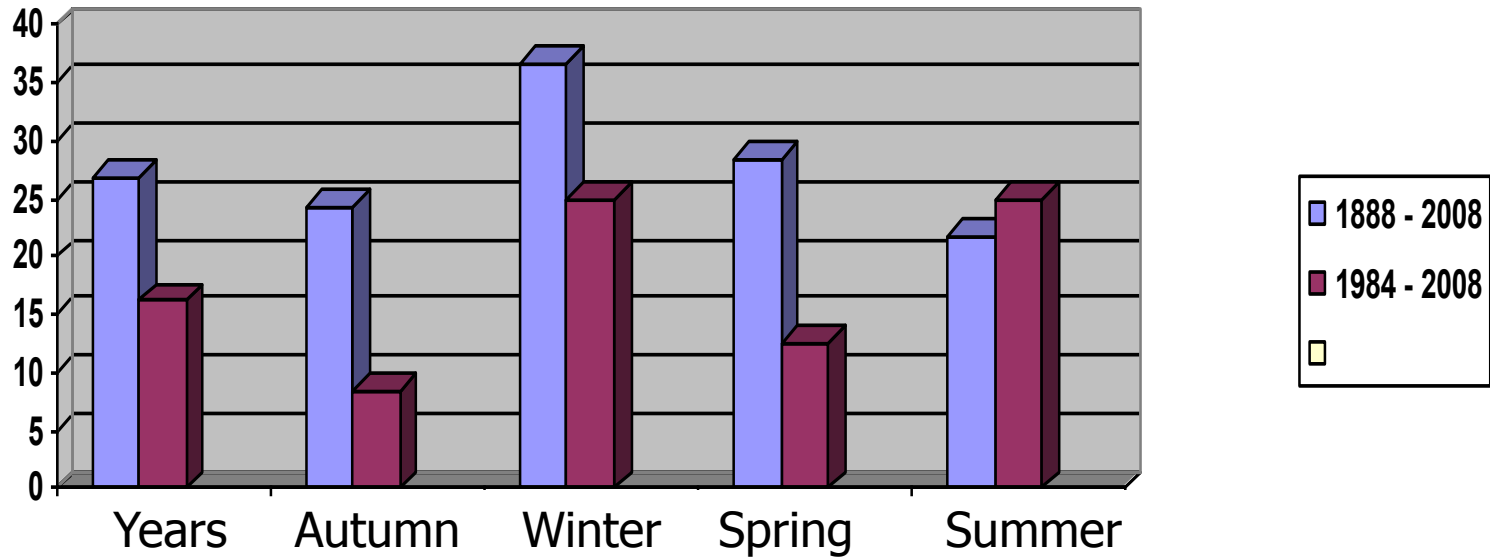
The influence of drought on the yield level of agricultural crops (1945-2007)

Droughts	Drop of the yield level, %		Probability, %
	average, %	flow	
Annual	-16,9	-5,7...-58,6	12,7 (9,7...16,1)%
Autumn	-1,8	-5,2...-16,5	32,5 (32,2...37,0)
Spring	-32,8	-18...-46,1	24,6 (22,6...27,4)
Summer	-14,8	-4,1..-25,1	20,9 (17,7..27,4)

Frequency (%) of years and seasons with a higher level of air temperature (1888 - 2008)



Frequency (%) of years and seasons with a lower level of air temperature



Extreme temperatures (1945-2007)

	years (in %), including in the months of:					
	May	June	July	August	September	total
Average in the country:						
>30c	9,6	22,5	27,7	26,7	10,3	62,3
>35c	5	9,3	13,5	20,9	1,43	9,1
North region:						
>30c	16,1	54,8	64,5	66,1	22,6	44,8
>35c	0	3,2	4,8	9,7	0	3,5
South region:						
>30c	25,8	78,9	98,2	87,7	96,9	61
>35c	1,6	5,3	21	21	0	5
<i>Sunny days – 290-322 annually</i>						
<i>Summary of insolation – 2050-2300 hours per year</i>						

The influence of extreme temperatures on the yield level of agricultural crops (1945-2007)

Crops	Decrease of the yield level (average, %)	flow, %
Winter wheat	-24,3	-16,8...-45,9
maize	-16,5	-5,4...-43,3
sunflower	-11,9	-5,0...-28,3
Sugar beet	-8,0	-0,34...-31,0
vines	-17,4	-2,4...-46,1
fruits	-22,4	-7,45...-64,7

The influence of the sum of positive temperatures on the yield level of crops (1946-2007)

Amount of temperature	years	Annual parameters:		yield, ch/ha					
		t°C	rainfal	wheat	maize	sunflower	Sugar beet	grapes	fruits
3000-3300	4	+8,11	540,4	18,5	25,3	12,6	213,7	42,9	52,4
3310-3450	18	+8,72	576,1	27,3	29,1	15,5	239,7	51,0	52,6
3460-3600	19	+9,06	535,4	25,7	31,0	14,9	228,1	46,3	52,3
3610-3900	18	+9,62	532,0	23,8	26,7	14,0	210,5	41,7	40,7
3910-4000	3	+11,17	467,0	24,2	24,5	12,5	216,5	42,9	41,3

The "r" coefficient – the correlation between the volume of rainfall and the yield level of crops (1946 - 2007)

Crops	r1 (up to 580 mm)					r2 (> 580 mm)				
	annual	autum n (79,8 - 107,9)	winter (110-130)	spring (168,5m m)	sumer (220-250)	annu al (>580 mm)	autum n (>108)	winter (>130)	spring (>168,5)	sum mer (>250)
Winter wheat	+0,305	+0,267	+0,086	+0,257	+0,145	+0,014	+0,065	-0,021	+0,193	+0,451
maize	+0,254	+0,378	+0,317	+0,493	+0,485	+0,459	+0,08	+0,296	+0,328	+0,384
sunflower	+0,453	+0,037	+0,299	+0,227	+0,18	-0,238	-0,416	+0,294	-0,146	-0,386
sugar beet	+0,457	-0,108	+0,03	+0,252	+0,424	-0,035	-0,137	+0,104	+0,061	-0,203
vines	+0,334	+0,08	+0,248	+0,168	+0,186	-0,11	-0,425	-0,464	-0,278	-0,522
fruits	+0,116	-0,091	+0,134	+0,079	+0,228	-0,023	-0,13	+0,252	-0,18	-0,134

The "r" coefficient – the correlation between the temperature and the crops' yield (1946 - 2007)

Crops	r1 (up to optimum)					r2 (higher than optimum)				
	annual t°C (+8,79..+9,66)	autumn t°C (+9,0...+9,4)	winter t°C (-1,57..-2,4)	spring t°C (+8,74..+9,16)	summer t°C (+19,0)	1	2	3	4	5
Winter wheat	+0,166	-0,474	+0,393	+0,344	+0,348	-0,217	-0,135	-0,01	-0,119	-0,454
maize	+0,112	+0,173	+0,318	+0,168	-0,05	-0,319	-0,194	-0,227	-0,097	-0,632
sunflower	+0,453	+0,037	+0,294	+0,227	+0,18	-0,238	-0,416	+0,299	-0,146	-0,386
Sugar beet	+0,437	-0,108	+0,104	+0,252	+0,424	-0,035	-0,137	+0,03	-0,061	-0,203
vines	+0,334	+0,008	+0,248	+0,168	+0,186	-0,11	-0,425	-0,464	-0,278	-0,522

The r, t and rainfall volume correlation coefficients (1946 - 2002)

Temperatures	Rainfall				
	annual	autumn	winter	spring	summer
annual	-0,320				
autumn		-0,204			
winter			-0,194		
spring				-0,281	
summer					0,514

The solar activity, meteorological parameters and crop yield

	Years observed	rainfall, mm	t°C	yield, ch/ha			
				wheat	maize	sunflower	Sugar beet
1) Average for the entire duration	62	525,6	+9,25	23,8	28,75	14,6	226,1
2) Years with minimum activity	7	416,7	+9,41	19,4	21,8	11,5	165,4
3) Years with maximum activity	6	652,7	+9,32	24,85	29,6	14,3	218,5
4) Years with transitional activity	49	525,6	+9,21	24,3	29,5	14,9	235,7
+/- var.2/var.3	-	-236,0	+0,09	-5,45	-7,8	-2,8	-53,1
(%%)	-	-36,1%	+0,96 %	-22,0%	-26,3%	-19,6%	-24,3%
Humidity coefficient (m3/t)							
var.1				1545	1279,6	2520	162,8
var.2				1610	1338	2536,0	176,3
var.3				1431,7	1126,3	2208,4	145,4
var.4				1575	1323,0	2738,6	179,2

The resistance of maize hybrids to drought depending on the vegetation period/plant life

Duration of vegetation	Number of genotypes	Distribution (%)		
		Highly resistant	Average resistance	Sensible
Early group	8	42,8	42,8	16,4
Semi-early group	12	16,7	41,7	41,7
Medium group	15	13,3	26,6	60,1
Semi-late group	15	6,7	53,3	40,0
Late group	8	12,5	37,5	50,0

Winter wheat varieties resistant to the drought phenomenon

Indicators	Number of genotypes	year 2007		ch/ha in 2006; 2008
		ch/ha	Implementation % ,	
1. The average for varieties in the testing process	38	27,8	59,0	47,05
2. The average for the drought resistant varieties	17	30,1	67,3	47,9
3. Varieties resistant to the entire group				
ch/ha		+2,3	+8,3	+0,85
%%		+9,4	+12,3	+1,8

Maize hybrids resistant to drought

Indicators	Number of genotypes	year 2007		ch/ha in 2006; 2008
		ch/ha	Implementation % ,	
1. The average for varieties in the testing process	57	27,5	43,5	63,2
2. The average for the drought resistant varieties	12	34,2	49,2	64,1
3. Varieties resistant to the entire group				
ch/ha		+6,7	+5,7	+0,9
%%		+23,5	+11,5	+1,4

Sunflower varieties resistant to drought

Indicators	Number of genotypes	year 2007		ch/ha in 2006; 2008
		ch/ha	Implementation % ,	
1. The average for varieties in the testing process	52	5,1	20,9	24,4
2. The average for the drought resistant varieties	7	7,8	33,3	23,8
3. Varieties resistant to the entire group				
ch/ha		+2,7	+12,4	-0,73
%%		+18,3	+37,2	-2,8

Sugar beet varieties resistant to drought

Indicators	Number of genotypes	year 2007		ch/ha in 2006; 2008
		ch/ha	Implementation %	
1. The average for varieties in the testing process	27	367,2	64,7	567,2
2. The average for the drought resistant varieties	12	416,7	74,5	587,6
3. Varieties resistant to the entire group				
ch/ha	-	+49,5	+9,8	+20,4
%%		+21,8	+15,1	+3,5

The role of technical and scientific progress (TSP) in compensating for the negative consequences of drought (1946-2007, country average)

	Volume of rainfall	Level of yield (ch/ha)			
		wheat	corn	sunflower	Sugar beet
The average for the years with a lower TSP*:	538,2	17,3	22,9	12,3	196,5
- high humidity years	622,8	19,7	27,1	13,2	203,5
-dry years	453,6	14,9	18,6	11,5	189,5
+/- ch/ha	-	-4,8	-8,5	-1,7	-14,0
b %%		-27,7	-37,1	-13,8	-7,1
The average for the years with a higher TSP **:	537,2	33,5	35,9	17,5	266,3
- high humidity years	607,1	33,1	37,4	17,5	264
-dry years	467,4	33,8	34,3	17,5	268,7
+/- ch/ha	-	+0,7	-3,1	+/-0	+4,7
b %%	-	+2,1	-8,6	-	+1,7

* Level of mechanization - 55,7 c.p. for 100 ha

Use of fertilizers - 10,3 kg/ha

Use of pesticides - 1,95 kg/ha

** level of mechanization - 158,5 c.p. for 100 ha

Use of fertilizers - 118 kg/ha

Use of pesticides - 9,25 kg/ha

List of crops according to resistancy to drought

Fodder sorghum	1
Sugar sorghum	1
Triticale	2
Millet	2
Buckwheat	2
Oatmeal	2
Beans	2
Alfalfa	2
Spring barley	3
Rye	3
Sainfoin	3
Sunflower	3
Winter wheat	3
Sugar beet	4
Corn	4



Non-traditional crops resistant to drought

Crops	Yield ch/ha green mass	Rating
1. Topinambur <i>H. tuberosus</i>	1400-1500	1
2. Silfia	1100-1200	1
3. Mallow (malva) (<i>Malva grabra</i>)	1200-1300	1
4. Sida (<i>Sida hermaphrodita</i>) Virginia Mallow	700-800	2
5. Fodder rumex (sorrel) F1	1100-1200	1
6. Sulfine (<i>Melolonthus album</i>)	1500-1600	1
7. Elephant grass (<i>Miscantus sinensis</i>)	1100-1200	2
8. Grass (<i>Pennesetus purpureum</i>)	1100-1200	2
9. Canadian poplar (<i>Plopulus deltoids</i>)	60-100	3
10. Chinese lemon (<i>Hurmulus lapulus</i>)	20-30	4

Problems to be tackled in the nearest future:

- Adoption of a structure of field crops in favour of drought resistant crops (tab.16-20);
- Restoring of the volume of land suitable for irrigation;
- Development and implementation of technologies adapted to unstable soil and climate conditions, as well as a forecast on the phytosanitary situation;
- Reviewing the variety of field crops encouraging varieties (hybrids) with a high adaptive potential and increased drought resistance;
- Arranging a monitoring system for the continuous climate change in order to forecast meteorological phenomena for periods of 2-3, 4-5 and 10-11 years;
- A gradual increase of subsidies in agriculture supporting the procurement of up-to-date irrigation equipment and modern technologies.