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METEO-CLIMATIC RISKS IN THE TIMIŞ PLAIN WITH IMPACT ON AGRICULTURE

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Abstract: The paper aims at investigating the thermal stress and risk factors within the maximum sensitivity period of the winter wheat (heading - flowering - grain filling). Through their intensity, frequency and duration, they may have negative effects on the vegetation state, finally determining the reduced, moderate or severe crop yield reduction. The study was carried out at two meteorological stations, situated in the Timiş Plain: Timişoara and Banloc.
Knowing the incidence, frequency, duration and intensity of the agrometeorological stress and risk parameters and of crops vulnerability, it gives the possibility to minimize their impact on the yields by adopting certain efficient strategies and measures for protection at local level.
Key words: meteo-climatic risk, critical phenophase, winter wheat, agriculture, the Timiş Plain**.**

Rezumat: Riscuri meteo-climatice în Câmpia Timişului cu impact asupra agriculturii .
Lucrarea are ca obiectiv investigarea factorilor de stres termic şi de risc din perioada de maximă sensibilitate a grâului de toamnă (înspicare – înflorire – umplerea bobului). Prin intensitatea, frecvenţa şi durata lor pot avea efecte negative asupra stării de vegetaţie, determinând în final reducerea uşoară, moderată sau severă a producţiei. Studiul s-a desfăşurat la două staţii meteorologice situate în Câmpia Timişului: Timişoara şi Banloc.
Cunoscând incidenţa, frecvenţa, durata şi intensitatea stresului agrometeorologic şi ai parametrilor de risc şi ai vulnerabilităţii recoltei, apare posibilitatea de minimizare a impactului lor asupra producţiilor prin adoptarea anumitor strategii şi măsuri de protecţie la nivel local.
Cuvinte cheie: risc meteo-climatic, fenofază critică, grâu de toamnă, agricultură, Câmpia Timişului.

The Timiş Plain, as part of the Banat Plain, offers extremely favourable conditions to cereal and technical crops through its agroclimatic resources. The large variability of meteo-climatic factors determines the appearance of thermal, hydrological and combined risks, which have an important role in the fluctuation of yields from year to year. The analysis of the evolution of the climatic parameters on long periods, of the intensity, duration, frequency and vulnerability of the main crops enables an optimal usage of the climate through/by:

- choosing the variety and the hybrids with respect to the bioclimatic requirements and the hydrothermal potential of crop area (Bîlteanu, 1998);
- adapting the geotechnical measures, which correspond to the agrometeorological conditions specific for each vegetation season, by taking preventive measures, especially during the periods and in the areas with a big probability of producing the risk phenomena (Ceapoiu, under coordination, 1984);
- adopting the right decisions in the optimization of crop plans and the optimal exploitation of the irrigated areas (Grumeza, Merculiev, Klepş, 1989).

In this way, one of the basic characteristics of a variety of winter wheat is the stability of the yields, that is "the full expression of the production potential under restricting conditions of the environment" (Săulescu, 1984).

During the vegetation season of winter wheat, its requirements towards the meteorological conditions differ from a phenological phase to another, reaching the highest values during the critical periods, specific for the crop. If during these periods there are positive or negative deviations from the optimal values necessary for the development of the vegetative processes in good conditions, the agrometeorological factors become stressful, sometimes of risk, with different intensities in accordance with the dimension of the deviations, having in this way a negative impact on the vegetation state and on the obtained yield (Povară, 2000).

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In this paper there are analyzed the parameters of stress and thermal risk for the interval May-June, which corresponds to the phenological phases with maximum requirements for winter wheat: heading- flowering- grain filling.

THERMAL RISKS

In May and June, the winter wheat crosses critical phenological phases of heading-flowering-grain filling with an optimum necessary of daily average temperatures between 16°C and 22°C (table 1). On the temperatures scale there are certain lower and upper limits in which the intensity of the biological processes is in an obvious correlation with the values of this parameter. Besides these limits, the intensity of the processes decreases considerably or even stagnates, the respective temperatures becoming in this way a stressful factor and even a factor of risk for plants (Povară, 1998).

Table 1.

Winter wheat requirements in relation to air temperature

Month	The potential phenological phase	Air temperature (°C)			
		Lethal	Minimum	Optimum	Maximum
May	- straw extension - heading - flowering	< 8°; > 35°	8° - 10°	16° - 20°	30°-35°
June	- heading - flowering - milk material - wax material - complete material	< 8°; > 35°	8° - 10°	16° - 22°	30°-35°

Thermal anomalies have the highest frequency 30,5 percent respectively 25.0 percent, both in the warm and cold years at Timişoara, and the grade of thermal normality in the Timiş Plain is very high at both stations in June (Table 2).

Table 2.

Thermal anomalies in the months with maximum requirements

Station/ month	Warm		Cold		Normal	
	V	VI	V	VI	V	VI
Timişoara	30.5	19.4	25.0	19.4	44.5	61.2
Banloc	26.3	21.1	26.3	21.1	47.4	57.8

The maximum critical temperatures ≥ 32°C

In May, maximum critical temperatures are present as a stressful phenomenon at both stations in the Timiş Plain with a low frequency (11.76 percent at Banloc and 8.82 percent at Timişoara), but higher (20.59 percent) in June. The stressful years were: 1961, 1962, 1963, 1965, 1967, 1968, 1969, 1981, 1983, 1991, 1993, 1994, common years in majority, and the years of risk were: 1962, 1963, 1967, 1968, 1994 (Table 3).

Table 3.

The frequency (%) of the maximum critical temperatures ≥ 32°C in stressing years

Years	Timişoara		Banloc	
	May	June	May	June
1961	-	8.82	-	5.88
1962	-	20.59	-	20.59
1963	-	20.59	-	17.65
1965	-	8.82	-	8.82
1967	-	14.71	-	8.82
1968	8.82	17.65	5.88	11.76
1969	8.82	8.82	11.76	-
1973	2.94	-	-	-
1981	-	-	-	8.82
1983	5.88	-	-	-
1991	-	8.82	-	-
1993	-	5.88	-	5.88
1994	-	11.76	-	11.76

Source: data processed from NAM

The minimum critical temperatures ≤ 14°C and ≤10°C

The thermal stress produced by these temperatures is more severe in May than in June. Thus, the crops were affected at both stations in May and on the whole analyzed period, with a maximum frequency (91.18 percent) of those of ≤14°C in the stressful years 1976, 1978, 1987, 1991 and 1992. In June, it has been observed a small decrease of the thermal stress with a maximum frequency of only 61.76 percent in only three years: 1967, 1989, and 1993. The minimum temperatures ≤10°C, more dangerous for plants, had a rather high frequency in May (maximum 64.71 percent) at Timişoara in 1991, and the thermal stress was much diminished in June, the maximum frequency (29.41 percent) has been observed at both stations only in 1962 and 1967 (table 4). The stressful years, which became of risk due to the high frequency of minimum temperatures of ≤14°C were: 1968, 1969, 1973, 1976, 1978, 1980, 1983, 1987, 1989, 1991, 1992, 1993 (May) and 1961, 1962, 1967, 1989, 1991, 1993, 1994 (June). For the minimum temperatures of ≤ 10°C, the stressful years turned into years of

risk were: 1976, 1980, 1987, 1989, 1991, 1992, 1993, 1994 (only for May).

Table 4.
The frequency (%) of the minimum critical temperatures in stressing years

Years	Timişoara				Banloc			
	Min. T. < 14°C		Min. T. < 10°C		Min. T. < 14°C		Min. T. < 10°C	
	May	June	May	June	May	June	May	June
1961	-	52.94	-	2.94	-	58.82	-	0.00
1962	-	52.94	-	29.41	-	50.00	-	29.41
1963	-	47.06	-	5.88	-	44.12	-	8.82
1965	-	47.06	-	5.88	-	50.00	-	5.88
1967	-	61.76	-	29.41	-	58.82	-	23.53
1968	67.65	50.00	20.59	11.76	55.88	35.29	20.59	8.82
1969	76.47	-	26.47	-	67.65	-	29.41	-
1972	-	41.18	-	2.94	-	-	-	-
1973	82.35	-	41.18	-	-	-	-	-
1976	91.18	-	55.88	-	85.29	-	55.88	-
1978	88.24	-	44.12	-	91.18	-	38.24	-
1980	85.29	-	61.76	-	82.35	-	58.82	-
1981	-	-	-	-	-	29.41	-	2.94
1983	73.53	-	29.41	-	-	-	-	-
1984	-	-	-	-	82.35	-	32.35	-
1987	91.18	-	52.94	-	91.18	-	47.06	-
1989	82.35	-	47.06	-	88.24	61.76	47.06	8.82
1991	88.24	52.94	64.71	8.82	91.18	-	70.59	-
1992	91.18	-	47.06	-	88.24	-	52.94	-
1993	-	55.88	-	8.82	82.35	61.76	23.53	20.59
1994	-	50.00	-	14.71	-	55.88	-	17.65

Source: data processed from NAM

The impact of critical temperatures on the wheat crop

The excessive temperatures starting from the period of straw extension until the end of vegetation are harmful to winter wheat, their negative effect become more prominent if they are accompanied by the insufficiency of the air and soil humidity (Povară, 2006). During the heading - flowering - grain filling period, the pedological drought together with the atmospheric drought and high temperatures (days of intense heat) create a disequilibrium in the metabolism of the planet, the level of perspiration exceeds the one of absorption, the migration of substances towards the grain is greatly diminished, producing the phenomenon of shriveling the grains. These temperatures registered in successive days, on a longer period of time, cause an earlier development of phenological phases and force the processes of ripening by shortening the period of grain filling. Thus, it may frequently appear disparities between the normal data and the real one of materialization of the respective phases up to 10- 15 days (Povară, 1999). Regarding the heading phenophase, which occurs earlier than the normal phase in the Timiş Plain, in 62 percent of cases, due to the very early spring, generated by the Submediterranean influences, specific to this geographical region (table 5), in comparison to the Romanian Plain, where the frequency of earlier producing is of 41-52 percent.

Table 5.
The frequency (%) of the heading anomalies in comparison with the Romanian Plain

Station	Normal	Earlier	Later
Timişoara	34	**62**	4
Băileşti	48	48	4
Alexandria	41	52	7
Călăraşi	52	41	7

Source: data processed from NAM

The minimum temperatures under 14°C and 10°C produced in a large number of successive days in May can influence drastically the yield, for example the year 1992, when the whole month of May had minimum temperatures under these critical values. At Timişoara, it was recorded a quarter of the productive potential of Fundulea 29 variety (fig. 1).

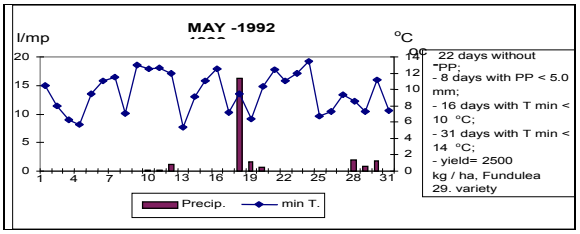

Fig. 1 Meteo-climatic parameters in the heading – flowering – grain filling period of the winter wheat – Timişoara

Conclusions

The analysis of meteo-climatic parameters of stress and thermal risk of the maximum sensitivity period of winter wheat in the Timiş Plain pointed out the following:

- the thermal anomalies had normally the grade 1 and 2 and they have occurred in intervals of maximum 2-3 successive years, at both stations;
- the frequency of the years with days of intense heat (maximum temperatures ≥32°C) was higher at both stations in June during the extremely stressful years: 1962, 1963, 1968, 1994, causing the phenomenon of shriveling the grains;
- in the Timiş Plain, the phenomenon of shriveling the grains is less frequent and intense in comparison with the agricultural areas from the Romanian Plain and implicitly the yields are less affected;
- the minimum critical temperatures ≤14°C and ≤10°C were presented as phenomenon of risk in both months and at both stations, the highest frequency, up to 91.18 percent, being that of ≤14°C in May, in the very stressful years, which

became years of risk: 1976, 1978, 1987, 1992;

- the climatic stress determined by the maximum and minimum critical temperatures it is not always produced simultaneously in the both consecutive months, fact which favours in a way, the agricultural crops;
- the highest reductions of yield determined by the action of stress and thermal risk are due to the high frequency and succession of minimum critical temperatures of ≤ 10°C during the heading-flowering- grain filling period (in May and June).

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