MAJOR WEATHER ELEMENTS INFLUENCING PLANT CULTIVATION IN CSONGRÁD COUNTY

by

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The whole area of the county belongs to the dry, warm climatic zone with hot summers—, in fact it is the most typical representative of it. Its yearly cloudiness is small, varying between 50% and 55%. Its winters are relatively more cloudy. Fog is frequent in the winter half of the year; in summer, however, it the most cloudless region of this country. The average cloudiness of August does not even reach 35%. The result of little summer cloudiness is an abundance of sunshine, and the area is the sunniest part of the country. The yearly total of its sunshine hours is over 2100. Its favorable sunshine conditions are most conspicuous in the summer half of the year; its winter sunshine supply is, in comparison with other regions of the Great Plain, not so favorable *(Tabl. 1.)*.

The significant differences appearing during each particular year show a close connection with the cloudiness conditions of the area. In our case this appers with the August minimum and the December maximum. More considerable variation in the amount of sunshine can be observed generally in the springtime. The nearly 100-hour difference of the month of May influences considerably the development of the vegetation.

During each month the values of the total of the sunshine hours vary by about one-third in both the positive and the negative sense. From the point of view of cultivation, the values of the sunshine hours of the vegetation period are the important thing. The total of the hours of (1) average sunshine (2) most sunshine and (3) most cloudiness in the vegetation period in the mean of 20 years is

1. 1749.8 hr
2. 1841.8 hr
3. 1555.7 hr

This extremeness, which may mean as much as 300 hours, makes itself strongly felt in the vegetation period in the cultures requiring much sunshine, not to speak of the values of the extreme cases which in the average of 20 years were 2.437.4 in the year with most sunshine and 1934.0 hr in the year with most cloudiness in Szeged. In this case the difference amounts to as much as 500 hr.

The values of sunshire hours differ not only in time but also regionally within the county. The largest number of sunshine hours is found in the region

TABLE 1.

Total sunshine hours of (1) average, (2) sunniest, and (3) cloudiest months in the average of 20 years (1938–1957) in Szeged

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
1.	68,4	93,9	145,1	202,3	249,4	282,5	321,6	300,7	227,8	165,5	72,4	57,4	2184,0
2.	105,3	164,0	232,7	279,9	311,0	367,6	372,4	350,1	280,9	217,5	118,3	94,0	2437,4
3.	40,8	27,1	80,0	129,4	170,6	191,1	215,6	245,8	180,2	98,1	43,2	35,1	1934,0

TABLE 2.

The extreme and differential probabilities of the monthly and annual mean temperatures on the basis of the average of 50 years

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual
maximum	5,4	6,3	10,3	15,4	20,5	23,6	25,8	24,4	21,5	17,5	12,0	5,9	12,8
10%	3,1	4,1	9,2	14,5	19,7	22,6	24,7	23,7	20,2	14,4	8,6	5,1	12,4
25%	−1,7	2,7	8,4	12,9	18,9	21,5	23,8	22,8	19,0	13,1	7,9	3,2	12,0
50%	−1,5	1,6	6,7	11,5	17,1	20,2	22,5	21,7	17,6	12,4	6,2	2,1	11,5
75%	−2,7	−0,8	4,9	10,9	16,0	19,3	21,1	20,6	16,4	11,2	4,5	−0,0	11,0
90%	−5,5	−3,0	2,9	9,2	15,2	19,7	21,1	19,7	16,0	10,0	3,3	−2,2	10,5
minimum	−8,7	−8,2	−0,1	8,2	12,4	17,9	19,3	18,1	12,5	7,6	0,7	−5,2	9,0
Average:	−1,0	0,8	6,5	11,7	17,2	20,4	22,7	21,7	17,7	12,1	6,1	1,6	11,5

of Szeged and in the northwestern part of the county. In the strip of land comprising the towns of Makó, Hódmezővásárhely, and Csongrád, however, the number of sunshine hours in the mean of many years is 50 hours less, and in the northeastern part of the county 100 hours less. We find the same regional distribution in the vegetation period although its importance in current plant cultivation (truck and garden cultivation, greenhouse cultivation) does not surpass the values of the yearly period. In the conditions of these cultures the number of sunshine hours in the winter period changes considerably owing to the frequency of the foggy days. In Szeged for instance 37.2 days are foggy. Their monthly distribution in the average of 15 years (1940–1954) is the following:

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
7.6	6.5	2.0	0.8	0.2	0.4	0.0	0.3	1.2	1.8	6.6	9.8

From the point of view of *temperature*, the chief climatic characteristic of this region is hot summers which finds expression nor only in temperature averages but also in the great frequency of intense warmings. The July mean temperature exceeds 22 °C. It is here that *the greatest number of summer days* (85–90 on average) occurs and also the greatest number of hot days (over 30). Long, warm falls are characteristic. The daily mean temperature sinks below 10 °C only after October 25, and the first fall frost occurs between November 1 and 5. The winters are moderately cold, the mean temperature of January is around −1.5 °C, the number of winter days varies between 25 and 30 days. In spring the daily mean of the temperature rises above 10 °C already between April 5 and 10 and the last frost in the area occurs between April 5 and 10.

The extreme air temperatures and the so-called cold and warm years and seasons are not at all indifferent from the point of view of the crop yields. A year is considered a cold year if the yearly mean of its temperature remains below 10 °C. Warm years are those with a yearly temperature average of 11.5 °C and a mostly mild winter. The cold and warm years generally occur in succession. The warmer period of about 4–5 years is followed by a relatively colder period of 1–2 years. The colder years usually go together also with a larger amount of precipitation. In the relatively cold years a generally cold spring is the rule, while the values of the summer and fall seasons do not show low temperatures. The explanation for this phenomenon is to be sought in the lower temperature and more precipitation of the winter. Its influence on the agriculture, especially in delaying germination, can be felt in a still greater degree.

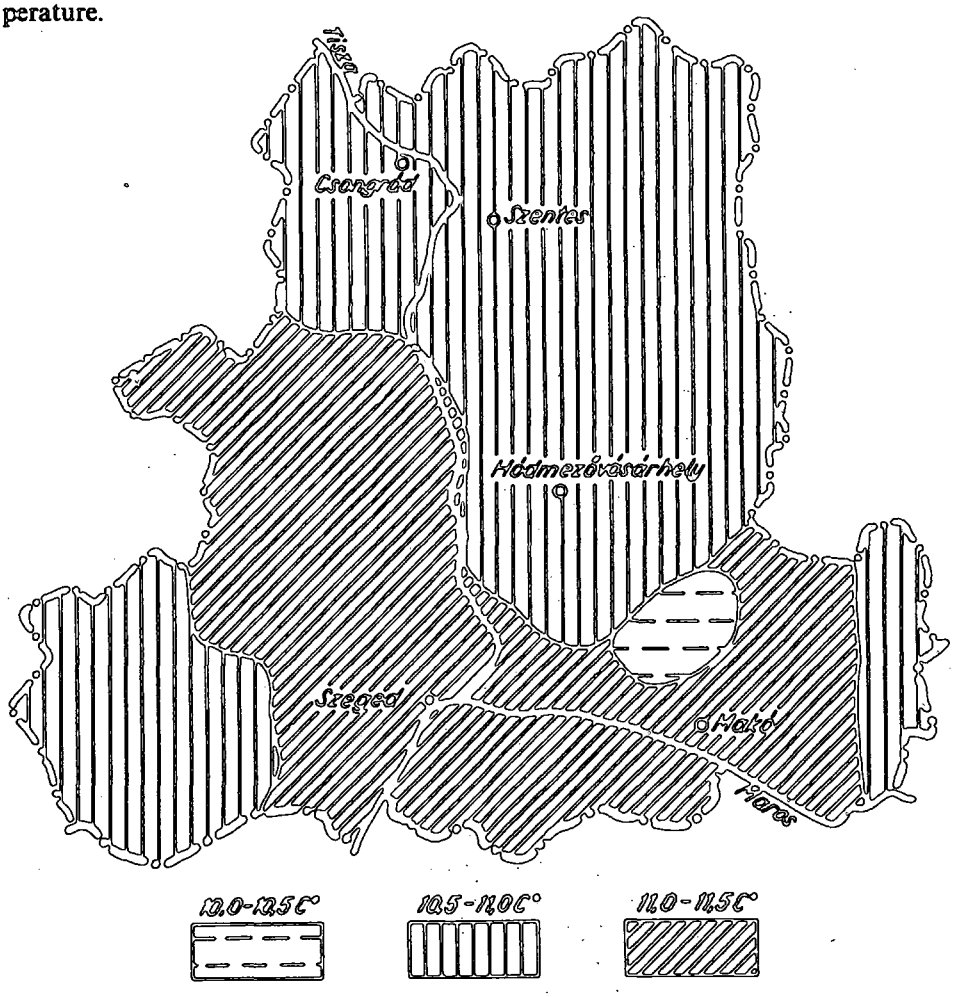
The temperature values in the fall period indicate a climate of submediterranean character, although microclimatically we also find climatic peculiarities of mediterranean character. Some differences of temperature occur also as a result of local effects. These factors create peculiar conditions within the small landscapes.

The limit values of the temperature extremes and those of the monthly and yearly mean temperatures of the different probabilities show well the extremeness which on the basis od Szeged's data over 50 years can also be applied also to the area of the country *(Table 2)*. It can be seen that the maxima and minima reach considerable magnitudes on the basis of the percentile frequency values, and knowledge of this is very important for cultivation. The area under discussion represents the so-called warm *sand steppe* type with continental values where the temperature conditions are suitable for a culture with a high heat requirement.

Long autumns are frequent in the area of the county, and this is favorable for the ripening of the late and afterseed plants. Also frequent are the winter seasons when the average temperature hardly sinks below 0 °C, but it also occurs

that on bleak days without snow cover the air temperature sinks below −25 °C. Owing to the early spring and quick warming the temperature of the soil and the air reach an average value of 9−10 °C already in April.

On the basis of monthly and annual mean temperatures three microregions may be distinguished in the area of the county (Fig. 1). The southern part of the county is the warmest but there are no great differences of temperature between the microregions. In the territorial distribution of the temperature of the vegetation period only a difference of 1 °C can be found in the average temperature.



1. ábra. Annual mean tempreture (°C) (Average of 60 years)

The value of the temperature of the area in the average of many years varies between 17.8−18.6 °C. The average temperature of the summer half of the year is 18.1 °C, which corresponds to about 3340 °C heat total. (The annual heat total is 4263 °C.)

In the whole country the period between the first frosty day and the last frosty day is the longest in the county of Csongrád (210 days in Szeged), and

this is particularly favorable for cultivation. It can be seen from the averages of many years that the frosty days are frequent before April 5, there are hardly any between April 5 and 30, but even if there are some between May 1 and 10, they are very rare and they do not occur after the eleventh of May. Fall frosts occur rarely between October 10 and 25, and frequently after October 25.

The prevailing wind in this area is nortwestern, while the second most frequent is southeastern, which appears most often in the spring months. The relatively greater speed of this circulation suggests that it is connected with the „kossava", the often stromy southeast wind at the lower course of the Danube, which at the southeastern border of the country belongs to the more vigorous winds although it loses much of its strength.

The valley of the southern course of the Tisza constituting a considerable part of the county has, as compared with other areas, peculiar wind conditions. Lower barometric pressures and the frequency of NW—N and S wind directions are characteristic here. *(Table 3.)*

TABLE 3.

The average frequency of wind directions in %

	N	NE	E	SE	S	SW	W	NW	Calm
I	16,5	8,3	6,1	12,8	17,0	9,5	10,0	14,9	4,9
II	14,8	8,2	5,1	12,6	17,8	10,7	12,1	15,5	3,3
III	14,5	7,0	5,4	11,9	20,2	10,5	11,3	14,7	4,5
IV	15,4	7,8	6,0	11,0	18,6	10,4	11,7	15,6	3,5
V	15,2	9,6	6,9	11,2	16,4	10,5	11,3	13,7	5,2
VI	19,2	7,6	6,3	8,2	13,0	9,1	12,9	19,2	4,5
VII	17,0	7,5	4,9	5,8	11,1	8,1	15,3	24,1	6,2
VIII	16,4	7,4	6,1	8,5	11,3	8,3	12,9	22,3	6,8
IX	15,2	8,1	6,6	13,3	14,6	8,8	10,4	16,1	6,9
X	14,5	8,0	6,6	12,7	20,1	9,2	9,7	13,3	5,9
XI	13,7	8,0	7,0	13,9	20,7	10,3	8,8	11,8	5,8
XII	14,1	8,3	6,3	13,9	19,3	9,8	10,8	12,5	5,8
Annual	15,5	8,0	6,1	11,3	16,6	9,6	11,4	16,2	5,3

The percentile frequency of the N and NW wind directions can well be seen from the table. This also means in practice that two air-mass conditions quite different from each other in their influence on the humidity conditions of the area are prevalent. This is because the area gets the largest amount of precipitation, on annual average about 160 mm, in the case of NW winds. Similarly considerable is the precipitation brought by W winds, about 150 mm on annual average, while N winds bring only 80 mm. The smallest amount of precipitation is characteristic here of the S and SE winds or air masses (36,5 mm). In the case of these latter the föhn or dry chirook effect makes itself felt very strongly. The dry desiccating wind causes atmospheric dryness which is especially harmful in the vegetation period. At such times evaporation increases considerably and strongly affects the physiological processes of the plants. As important cultures on sand must also be taken into account, the intensity of the air movements is not indifferent; protective measures must be taken against deflation, surface reshaping and other similar damage. The following table gives a survey of the wind intensity. *(Tabl. 4.)*

TABLE 4.

Percentile frequency of winds stronger than 3 degrees on the Beaufort scale (on the basis of the average values of many years)

N	NE	E	SE	S	SW	W	NW
9,3	10,2	5,8	6,8	14,9	6,3	20,4	26,3

The value limit of 3 degrees on the Beaufort scale was chosen on the ground of the consideration that air movements stronger than this are already important in the reshaping of the ground surface. Winds stronger than this most often belong to the NW—W directions. In this case, however, the reshaping of the surface becomes insignificant with the air movement combined with precipitation. The same cannot be said in the case of the *southerly* winds, when the more vigorous air movement reaching a high percentage and usually combined with a dry period, causes serious damage by the destruction of the surface, increased evaporation, atmospheric dryness, etc.

A very important meteorological factor of agricultural production is precipitation. It has been ascertained that since the turn of the century precipitation in the area has shown a growing tendendy. In comparison with the first decades of the turn of the century the spring, late fall, and early winter months have become dryer, and the other months relatively more rainy. Of course this manifests itself only in great generality, However, independently of this phenomenon we must consider the epithet *extreme* valid also further which in the course of the individual years manifests itself in great differences in both quantitative and temporai respects.

The average yearly rainfall in the region of the mouth of the river Kőrös is only 500 mm, but at the mouth of the river Maros 580 mm *(Tabl. 5.)*. The rainiest month in the area is June when the normal amount of precipitation is

TABLE 5.

Precipitation in mm (Average of 50 years)

Period	Csongrád				Makó			
	average	maximum	minimum	75%	average	maximum	minimum	75%
I.	29	53	1	14	31	93	4	19
II.	30	82	1	13	33	114	1	16
III.	31	89	0	10	35	79	2	15
IV.	45	149	3	23	45	106	2	24
V.	58	129	8	34	60	206	13	35
VI.	59	142	9	37	75	178	11	51
VII.	46	158	2	20	50	165	3	25
VIII.	50	164	1	26	48	139	5	31
IX.	42	101	2	22	47	125	4	29
X.	46	147	0	17	49	160	4	22
XI.	48	127	2	23	50	139	2	22
XII.	36	161	7	17	42	108	8	23
Annual total	520	760	307	432	565	794	371	494

Hódmezővásárhely				Szentes				Szeged			
average	maximum 75%	minimum	average	average	maximum	minimum	75%	average	maximum	minimum	75%
31	133	2	16	31	102	1	16	32	111	3	19
31	130	0	16	33	107	0	15	34	126	1	18
34	90	1	15	33	92	1	13	38	104	2	16
48	125	5	26	47	185	9	26	49	135	6	29
60	175	11	37	61	159	8	37	61	197	11	37
67	184	6	44	62	139	8	47	68	129	19	46
51	131	0	30	46	148	2	24	51	112	6	22
50	124	6	27	50	151	6	32	48	131	4	28
48	141	1	29	44	120	2	24	47	127	3	27
46	135	5	22	47	146	2	17	52	138	3	21
47	123	4	20	49	145	5	24	52	142	3	21
42	121	9	23	39	121	10	21	41	105	11	24
555	913	397	487	542	937	394	474	573	867	348	466

60—70 mm, and the driest month is January when the normal amount of precipitation is 30—50 mm. The autumnal secondary maximum can be well demonstrated in the temporal variation the precipitation and submediterranean rainfall regime *(Tabl. 6.)*. There is much rainfall in late spring and early summer, but

TABLE 6.

Average precipitation (mm) in different pentads between 1890—1960 in Szeged

Pentads:	1	2	3	4	5	6
January	4,7	6,1	5,9	7,6	4,1	5,1
February	7,2	7,0	7,2	5,1	4,4	3,5
March	6,9	7,5	5,1	3,2	5,0	9,6
April	6,3	7,9	8,6	9,9	8,3	8,0
May	*11,9*	*11,8*	9,1	8,8	*10,5*	*13,8*
Juni	*12,7*	*10,4*	*13,2*	*11,3*	9,5	9,0
July	10,0	9,3	9,5	8,0	9,1	8,8
August	8,5	8,6	8,9	6,0	6,9	7,5
September	8,4	5,2	9,7	6,3	6,1	7,7
October	7,2	8,6	6,8	6,3	7,5	*13,4*
November	8,5	8,3	7,1	9,5	6,8	5,5
December	6,8	6,6	7,2	5,9	5,0	8,1

at the same time the occurrence of periods poor in rainfall may also be well observed on the basis of pentad values. These periods with little rainfall occur mostly in early spring, midsummer, late summer, and early autumn. In the evaluation of our table the autumn period and the more considerable rainfall of early winter due to mediterranean influence deserve special attention.

TABLE 7.

The probability of precipitationless periods (1) longer than 5 days, (2) longer than 10 days in 1936–60, % (Szeged)

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1.	17	21	28	17	14	17	32	30	39	30	19	20
2.	4	7	12	5	4	2	11	12	15	11	6	6

The following table proves occurrence of the dry period *(Tabl. 7.)*. Dry periods are frequent in March, July, August, September, and October, and the lack of rainfall badly affects cultivation.

In the secons half of the summer the probability of the occurrence of long rainless periods increases considerably in comparison with other regions of the country. For instance in the evaluation of the rainfall data of Szeged between 1871 and 1960 it was found that the probability of a lack of rainfall for at least 10 days is 10% in July and 13% in August, whereas the probability is 4% and 6% in Debrecen, 6% and 8% in Budapest, 4% and 6% in Keszthely, 5% and 6% in Mosonmagyaróvár. From this the conclusion may be drawn that the area has a great propensity to drout in late summer, generally double as great as can be seen from the rainfall data of 90 years at the places mentioned. The winter is poor in snow, the number of days with snow cover varies between 33 and 36, and even winters with no lasting snow cover are frequent. In the case of Szeged, for instance, we can expect that there will be no more than 3 days with snow cover. In spite of this a lasting snow cover may form in cold winters owing to the relatively more abundant winter precipitation. A winter has also occurred in Szeged when the ground was covered by a snow layer for 76 days.

On the basis of both the annual values and the values of the vegetation period it can be ascertained that in the succession of the years three years out of every four are relatively poor in precipitation. Scarcity of precipitation occurs especially in the summer period. In winter no larger amount than 40–54 mm of precipitation can be expected around 15% frequency. Of course amounts larger than 100 mm also occur, but they do not represent more than 2–3% of the casos. In the spring months, if we take a 15% frequency into consideration a precipitation of 60–90 mm falls; of course 160 mm of precipitation also may occur.

In the summer period the amount of precipitation varies considerably; the 15% value limit means 80–90 mm of precipitation; in the extreme cases on the other hand there is more precipitation in comparison to the former. The 15% probability value of the autumn months means about 60 mm of precipitation. As to the amount of precipitation, there are larger amounts in the warmer half of the year (in summer) than in the colder half. On the basis of experience gathered over several decades we know for instance that precipitation carger than 20 mm can be expected between May and October. Large precipitation yields in a short period are chiefly characteristic of July and August, which are known to be dry. The summer precipitation occurs chiefly in the from of showers, but destructive stroms are not very frequent. The more frequent are hails; in the summer months we may reckon with a probability of 31–50%.

As we have seen from the above, the 560 mm of precipitation that fell on

the territory of the county is too little for cultivation and is unevely distributed. Even besides the favorable temperature conditions the rainfall is unsatisfactory for plant cultivation. The low relative vapor content of the air (66%) in the vegetation period makes the situation even worse. Taking the optimal heat and precipitation requirement of the major cultures of the area into consideration we come to the conclusion that the temperature conditions are *very favorable* making possible the cultivation of plants with high heat requirement (vegetables, tomatoes, paprika), while the precipitation conditions are *unfavorable* for cultivation and cultivation can be made economic only by irrigation.

Our table containing the optimal heat and precipitation requirements of the more important agricultural plants and the temperature and precipitation values of the average of many (50) years shows well the favorable and unfavorable climatic conditions *Tabl. 8)*. The precipitation deficiencies visible in the climatic data must be compensated by irrigation.

TABLE 8.

The optimal heat and precipitation requirements of the more important agricultural plants and the annual average in Csongrád county

Months:	IX	X	XI	XII–II	III	IV	V	VI
Average of 50 years								
Temperature in °C	17,5	11,8	5,8	3,1	6,3	11,5	17	20,2
precipitation (mm)	46	51	51	104	37	49	60	67
			Wheat					
Optimal temperature in °C	18,7	10,5	6,5	−0,3	4,6	9,6	15,5	18,7
precipitation (mm)	52	38	20	71	26	51	83	64
			Rye					
Optimal temperature in °C	18,6	10,5	6,3	−0,3	5,7	9,4	15,4	19,6
precipitation (mm)	50	34	54	75	22	45	86	62

Months:	IV	V	VI	VII	VIII	IX
Average of 50 years						
Temperature in °C	11,5	17,0	20,2	22,4	21,5	17,5
precipitation (mm)	49	60	67	49	47	46
			Maize			
Optimal temperature °C	11,2	18,1	19,9	23,2	21,2	18,4
precipitation (mm)	49	81	58	57	57	45
			Potato			
Optimal temperature °C	10,5	17,5	19,1	21,9	21,0	16,5
precipitation (mm)	39	75	70	65	57	48
			Vegetables			
Optimal temperature °C	60	90	100	110	110	100
			Meadow pasture			
Optimal precipitation (mm)	60	70	70	90	90	70

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