

LIFE CYCLE OF THE MAIZE IN FRIULI-VENEZIA GIULIA AND SLOVENIA

ŽIVLJENSKI CIKLUS KORUZE NA OBMOČJU REGIJE FURLANIJE –JULIJSKE KRAJINE IN SLOVENIJE

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POVZETEK

V primeru koruze je fenofaza cvetenja ter zrelosti korelirana z določeno efektivno vsoto temperatur zraka nad pragom 10 °C EV(10 °C). Na podlagi petnajstletnih podatkov 34 fenoloških opazovalnih postaj na območju Slovenije in italijanske regije Furlanije - Julijske krajine, podatkov o maksimalnih in minimalnih dnevniških temperaturah za isto obdobje ter geografskih podatkov (nadmorska višina) so bile izdelane karte povprečnih letnih EV(10 °C), povprečnih EV(10 °C) v rastni dobi, povprečnih doseženih EV(10 °C) do fenofaze cvetenja ter karta verjetnosti za dosego EV(10 °C), ki ustreza pojavu fenofaze cvetenja, do določenega dne v letu. Pri izdelavi kart je bila upoštevana tudi korelacija med EV(10 °C) v določenem obdobju v letu ter nadmorsko višino. Na podlagi kart lahko vidimo, da obstajajo precejšnje razlike v klimatoloških karakteristikah med Slovenijo in regijo Furlanija - Julijska krajina. Na območju Furlanije - Julijske krajine, kjer koruzo pridelujejo, so sezonske vrednosti EV(10 °C) med 1400 in 1900 °C ter padajo v smeri od obale proti Alpam. Slovenija pa predstavlja precej bolj nehomogeno območje. V bližini italijanske meje (Vipavska dolina in obala Istre) so razmere podobne kot na območju regije Furlanija - Julijska krajina. Na vzhodni strani Alp pa so vrednosti EV(10 °C) precej manjše, zato je možno gojiti le zgodnjo koruzo. Na območju Slovenije vrednosti EV(10 °C) naraščajo v smeri od Alp proti Panonski nižini. Za koruzo obstaja velika verjetnost vodnega stresa v avgustu. Zaradi tega bi bilo najbolj ugodno, če bi do cvetenja prišlo že pred koncem julija. V južnem delu regije Furlanije - Julijske krajine obstaja velika verjetnost za to, v severnem delu, pa je verjetnost precej manjša. Zaradi tega je na tem območju smiselno gojiti srednje pozno koruzo namesto pozne koruze, še posebej če ni vzpostavljen namakalni sistem. Glavni namen študije je bil predvsem uporaba grafičnega prikaza agroklimatskih indeksov ter vključevanje povezav med fenološkimi ter geografskimi podatki za natančnejšo izdelavo fenoloških kart.

Ključne besede: fenologija, Italija, Slovenija, cvetenje koruze, vsota efektivnih temperatur, fenološke karte

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1 PHENOLOGICAL ACTIVITIES IN FRIULI-VENEZIA GIULIA

At the moment, in the region Friuli-Venezia Giulia, a phenological network doesn't exist. A first attempt was made in 1990, by ERSa (Regional Organization for Development of Agriculture), to study the cultivated arboreal and herbaceous crops, at the beginning of agro-meteorological activities. The network was closed in 1996. At the beginning of 1998 a phenological garden was founded in the town of Tarcento, in collaboration with the University of Udine.

2 CLIMATOLOGICAL APPLICATIONS

In this article we shall not describe real phenological activities but will describe an application of a phenological index in the Republic of Slovenia and in the region of Friuli-Venezia Giulia. In 1995, according to the decisions of the Italo-Slovenian Permanent Mixed Commission for the common defense against hail, a collaboration has been started between ERSa (through the Centre for Agrometeorological Services, CSA) and the Slovenian Hidrometeorološki Zavod (HMZ, Hydrometeorological Institute) to conduct studies in the agrometeorological field. The first activity was to stress how the differences in climate between the two regions influences the development of the crops, with the goal of evaluating the most adapted varieties to be cultivated in the different habitats. This study, just finished, has concerned maize and sunflower but, in this report, we are going to describe only the results obtained on maize.

3 METHODOLOGY ADOPTED

With the same environmental conditions (absence of or similar hydrothermal stresses), if the seeding or the emerging of the crop is contemporary in two different places, in the warmest place the crops will reach a fixed phase of development (phenological phase) first. If we know the relationship between temperature and phenological phase and if we have a climatological database for a whole region, it's possible to trace on a map, the climatological average times or the days of delay for a fixed phenological phase; otherwise it's possible to show the probability of not reaching physiological maturity of the crop. We know that temperature is one of the principal variables which influence development of crops. There are many methods of calculating and accumulating temperature or thermal units for maize. In this study we used the method of Growing Degree Units (GDU):

$$GDU = [(T_{max} + T_{min})/2] - 10$$

where T_{max} = daily maximum temperature, T_{min} = daily minimum temperature and 10 is the base temperature for growth. In maize the flowering and the maturity is

correlated with the reaching of some fixed accumulated GDU values as shown, for example, in table 1 for each class of maturity. Using the values of table 1 we create same maps for the following variables:

- GDU yearly mean accumulation;
- GDU mean accumulation in the growing period;
- GDU accumulation in the emerging-flowering stage;
- Probability of reaching the values of GDU corresponding to the flowering and physiological maturity, within a particular date.

We used almost 15 years of data from 34 meteorological stations (Figure 1) located in the two regions. At the beginning, to draw the maps, we looked for the relation between elevation of the place and the variable GDU or the probability. With this relationship we computed the probability for every pixel on the maps. On the maps of the spatial distribution of GDU we considered also the residuals of the regression between elevation and mean GDU at each station. These maps take into account the general trend of GDU, which decrease with altitude, and the local effects due to the micro-climatic conditions.

4 RESULTS

As an example, we report two maps. In Figure 2 is drawn the mean seasonal GDU (period May-October). You can see that the two regions have different climatological characteristics. In the area where maize is cultivated in Friuli-Venezia Giulia, GDU is between 1400 and 1900 and decreases from the coast to the Alps. In these conditions it's possible to grow medium-late maturing maize. Slovenia presents a less homogeneous situation. Near the Italian border (the Vipava valley and the Istrian coast) we have a situation similar to the one in Friuli. On the East side of the Alps, GDU is lesser and in these conditions it's possible to grow only early maize. Moreover, GDU grows from the Alps to the Hungarian plane. For maize, the probability of having hydrological stress in August is very high. For this reason maize flowering should occur before the end of July. In the lower plane of Friuli there is a high probability of this condition (Figure 3); in the high plane the probability is low. For this reason, in Friuli-Venezia Giulia it's better to cultivate medium maturing maize rather than late maturing, especially if there is no irrigation water.

5 CONCLUSIONS

From these studies emerges a large bio-climatic discontinuity between Friuli-Venezia Giulia and Slovenia on the divide of the Giulian Alps. On the East side of the Alps, maize has enough GDU only for the early classes to mature; on the West side the amount of GDU is greater and is sufficient for all the phenological phases, but to avoid water stresses, especially during flowering, it is better to cultivate medium maturing maize (e.g. FAO 500). This study is an attempt to represent in a graphical format the agroclimatic indexes, using a method that allows a global view of the territory. This method can be used, as well, to represent climatological and biological parameters. For this reason it should be important to find, in the area of interest, the relationships between phenological development and geographical data (e.g. altitude). To have other information, or a paper with a detailed description of the study, contact the technicians of CSA or HMZ.

Table 1: Growing Degree Units (GDU) to reach flowering and physiological maturity in different FAO classes for maize.

Class (FAO)	Growing Degree Units (GDU)	
	Flowering	Physiological maturity
100	620	1250
200	680	1300
300-400	730	1350
500	780	1400
600	820	1450
700	870	1500
800	920	1600

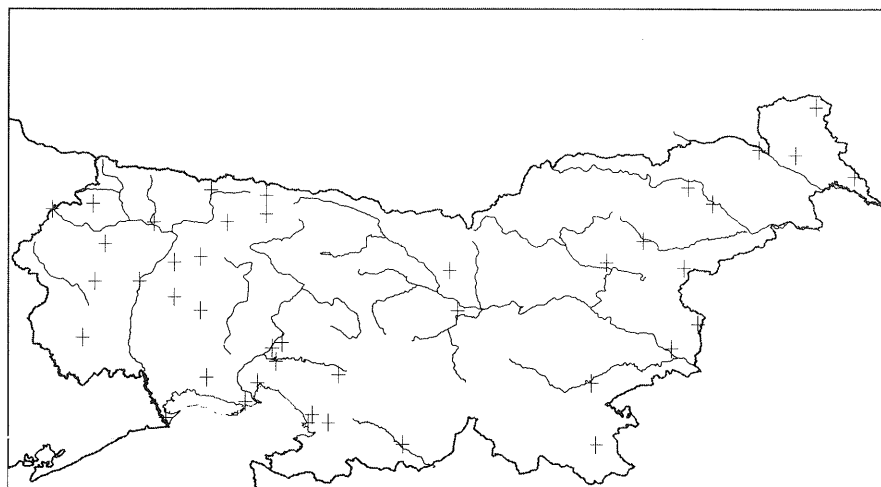


Figure 1: The 34 meteorological stations in Friuli-Venezia Giulia and Slovenia.

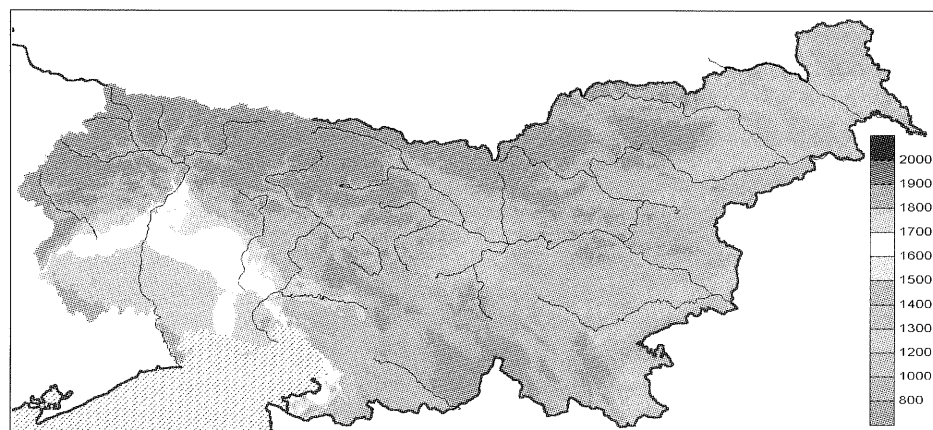


Figure 2: Accumulation of GDU above 10 °C in the period 1-May/31-October in Friuli-Venezia Giulia and Slovenia.

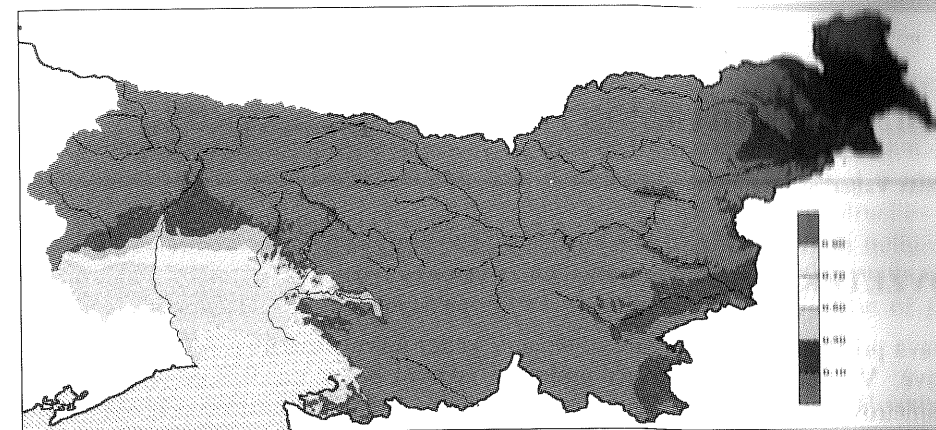


Figure 3: Probability to reach 850 GDU in the period 1-May/31-July in Friuli-Venezia Giulia and Slovenia.