AGRO METEOROLOGICAL CONDITIONS FOR CROP YIELD FORMATION

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Our contribution analyzes the effect of air temperature, total precipitation and sunshine duration on vegetative and generative phases of selected crops. The conditions on which depend achieved yields were studied in two parts. The first part deals with the effect weather conditions on a nationwide yields of field crops and compared with yields abroad, in a second, more detailed study is the agro-meteorological evaluation at five stations with different altitudes and different geographic and pedological conditions. Data of the growing season each year has always been compared with the normal range for the same days. In winter cereals were assessed both agro-meteorological conditions throughout the growing season (from germination to full ripeness) as well as from striking manifestations of spring vegetation (start lengthening stalks) into full ripeness. Monitoring conditions throughout the growing season include the impact of any crypto vegetation on one side and also the adverse effects of air temperature, causing the loss of frost resistance on the other. Spring-summer cycle allows to assess the impact of weather conditions to complete the process of revenue generation, both in terms of improving and accelerating potential, as well as in terms of aggravation and delays potentially sprouting and consequently yield losses.

Keywords: agro-meteorological evaluation, weather conditions, field crops, growing season

INTRODUCTION

Czech Republic ranks among the major crops producers how in the European Union and in the world. At the beginning of our work we present a few examples yields of different crops in comparison with other European Union countries or the world. As part of this review were presented yields the most important field crops, crops for industrial use and yields of the various fruits and vegetables. Also were listed examples of the average consumption of those fruits and vegetables per capita per year.

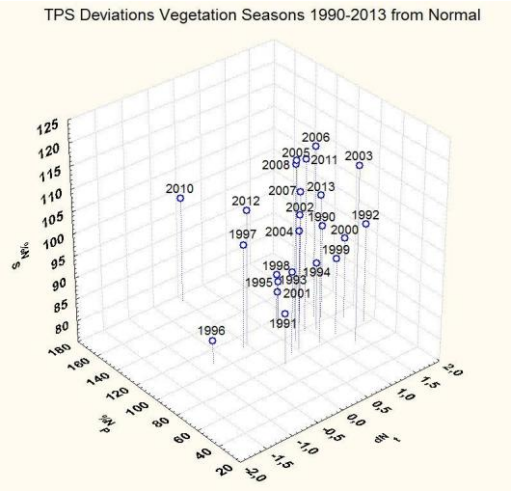
In the general assessment of the interaction between the emergence of the plants and weather, we drew on previously published papers (1, 2, 3, 4, 5). There were shown few examples of the two most important ways of evaluating vegetation. The first of these methods for assessment analyzes the relationship of vegetation during the three most important meteorological elements. Air temperature, precipitation totals and sunshine duration. It is a so-called method of dominant and submissive elements.

MATERIALS AND METHODS

Method of dominant and submissive elements was first introduced to the world congress ICB in Tokyo in 2008. Its principle is to assess the long time series usually taken in parallel phenological and meteorological data. The method is based on comparing variations in air temperature, precipitation and sunshine duration from normal. Using appropriately selected starting point is eliminated early negative temperature deviations and then transferred – as well as two other elements – into percentages.

When comparing all three types of variations in a given period (year or growing season) is the tallest of them considered the dominant element, and the lowest for the submissive element. This way we can show the dominant stimulatory influence of temperature, precipitation or sunshine, or contrary to their influence stressful.

A second method for evaluating the development of the plants together with the conditions of the external environment is a thermopluviosolarigram's method. On the scheme of virtual cubes can monitor the position of each subset defining specific growing seasons in Czechia from 1990 till 2013 year.



Since both these methods were described in detail in the works (4, 5), there is mention only a few examples of the resulting findings of randomly selected five phenological stations whose metadata are as follows:

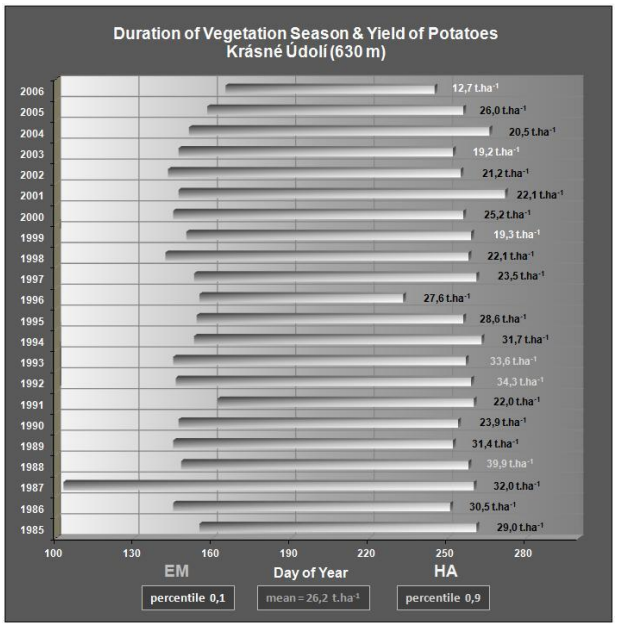
Doksany	14°10’	50°27’	158 m
Cholina	17°04’	49°40’	250 m
Staňkov	13°04’	49°33’	430 m
Keřkov	15°43’	49°36’	530 m
Krásné Údolí	12°55’	50°04’	630 m

RESULTS

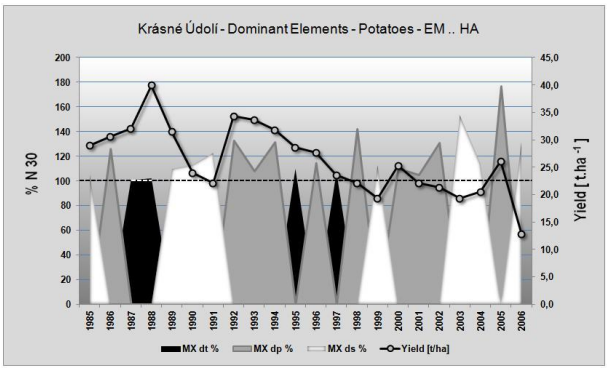
A) Dominant and submissive elements

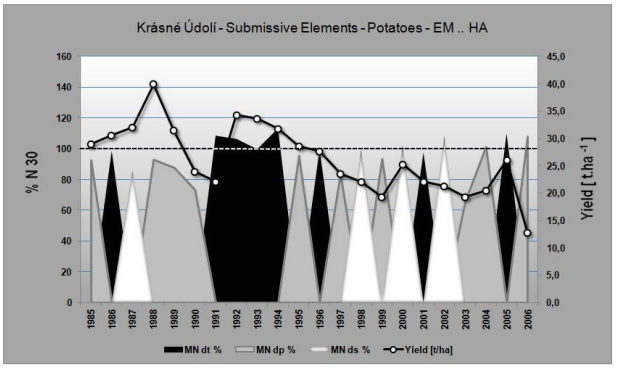
They were first examined the length of each growing season with regard to the amount of income each field crops at all stations. As an example, there is shown a graphical representation length of the potatoes growing season in the station Krásné Údolí.

At the same time the amount of revenues can be assessed within the upper and lower deciles and compared to the average yield.



Starting from the time series measurements of three basic meteorological elements, i.e. air temperature, total precipitation and sunshine duration, conforming to a specified length of growing season, and with thirty-mean (normal 1961-1990) for the same period, we found deviations from this normal and comparing the amount determined what elements in a given growing season are dominant and what elements are submissive.





The figures are shown already integrated the results of these investigations in the growing seasons each year.

B) Thermopluviosolarigram's methodology

Method TPSG again presents comparisons of three basic meteorological elements with vegetation data. However, in this case, in graphical form, which tells us more about the details.

Through the software environment that enables the creation of three-dimensional graphs can be expressed the character of any length of time.

In the above example, it was four a ten-year period, and the total observation period.

If - as here - going through the axis normal values always the centre of each wall of the virtual cube, it is possible to interpret the position of each point according to notes on the walls.

Proper orientation helping a vertical line from the point to the base.

This way you can very clearly express the main character's climate decade, year or growing season.

C) Detailed evaluation of individual growing season of field crops

The value of each crop in the growing season is only one number.

To understand these fluctuations in value from year to year, we must necessarily use more detailed analysis of the conditions in which they conducted various vegetative and generative phenophases to the ripeness.

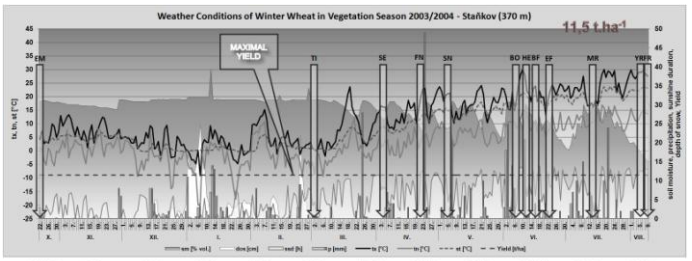
For brevity, we present the result of a random selection of five aforementioned stations. At these stations was carried out as phenological observations, so there were surveyed also precise data on crop yields, which were monitored.

The first step was to re-evaluate the length of each growing season.

For potatoes, spring barley, spring wheat, oats, maize and sugar beets regards the evaluation within the period from spring to summer or autumn of the same year.

For winter crops such as wheat, rye, barley and rapeseed, for these crops it is very important to assessing conditions of their hibernation.

In the final part, we are therefore now focused on the evaluation of the highest and lowest yields for winter wheat. From an overall assessment of all five stations at different altitudes here can only give an example from the central position.



CONCLUSION

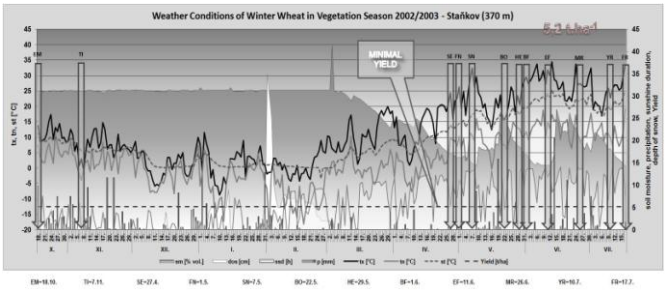
In this case, the two immediately following growing season at station Staňkov (370 m) is already apparent at first sight their difference.

In the 2003/2004 season following the period less successful it may be noted the good isolation of deep air temperature drop at the beginning of January through the freshly produced a high enough snow cover.

Further declines in air and soil temperature gets postponed until the beginning of tillering to early March, but the following favourable in the period until heading even ideal weather conditions had a major impact on the final result of yield.

Greater intervals between the end of flowering and milk ripeness, and between this and the yellow ripeness should the conditions in which complete formation of grain with a high weight.

The result was reasonably early next full ripeness.



Too early tillering at station Staňkov (370 m) from the beginning of November 2002 was one of the causes weakening further developing plants.

Insufficiently hardy plants were built in the first third of January sharp drop in air temperature and under low snow cover with higher water value has been further weakened plants.

Better insulation of snow in February failed to nothing more than keeping anyway already weak development of the wheat crop.

Quickly consecutive vegetative phenophase not allow plants to mature properly, so despite the good conditions in the flowering stage and after its termination would not lead to a higher yield.

LITERATURE

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