THE VERTICAL STRATIFICATION OF AIR TEMPERATURE IN WINTER WHEAT STAND IN THE YEARS WITH DIFFERENT COURSE OF WEATHER

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The vertical stratification of air temperature in stand was determined in three developmental stages of winter wheat (I – tillering to beginning of stem elongation, II – stem elongation to the end of flowering and III – development of fruit and ripening). Two years, 2011 and 2013, with different course of weather, were included in the comparison. The microclimatic data were obtained at the field trial station of the Mendel University in Brno in Žabčice (the Czech Republic, Central Europe). The wheat stand microclimate differed significantly from this of their surrounding environments. The air temperature was usually lower in the ground level and effective height in the wheat stand in the light period of the day. The lowest air temperature were measured in the active height of winter wheat stand during the night. These differences were dependent on winter wheat stage and the course of air temperature in the particular year, they were much pronounced during the light part of day and reached maximum around 2 pm GMT+1.

Keywords: wheat, microclimate, temperature

INTRODUCTION

The knowledge concerning the course of microclimate is inevitable for modeling plant growth and yield of crops and for prediction models of development of important plant pathogens. Canopy microclimate in comparison with conditions at standard climatological station is characterized by reduction of temperature extremes, wetter environment with lower changes, precipitation interception, reduced air speed, diffuse solar radiation and by different air composition (e.g. Středa et al., 2011). The plant diseases are result of interrelationships between host plant, pathogen and environment, especially weather and soil conditions. The appropriate temperature is inevitable for development of several pathogens stages during pathogenesis. For example Hau et de Vallavieele-Pope (2006) presents, the optimal temperature for the shortest incubation period is 20 °C for *Blumeria graminis*, 26 °C for *Puccinia triticina* and 26–29 °C for *Puccinia graminis*. According to the same authors, *Blumeria graminis* intensity of sporulation is higher in 18–22 °C, but lower in temperature above 27 °C. Also development of *Mycosphaerella graminicola* (anamorpha *Septoria tritici*) pycnidia is influenced by course of weather, especially temperature and humidity (Henze et al., 2007), with the optimum 18–22 °C during the day and 15 °C in the night (Chungu et al., 2001). The range of these parameters is used for prediction models of pathogen occurrence, but they are taken from climatological stations measured in 2 m above grass canopy, so the usually do not reflect actual situation in the stands of field crops. For these reasons, we evaluate the course of temperature in winter wheat stands during the years with different course of weather.

MATERIALS AND METHODS

Experimental locality, plant stand

The microclimatic data were obtained at the field trial station of the Mendel University in Brno in Žabčice municipality (GPS Loc: 49°1'18.658"N, 16°36'56.003"E) in the canopy of winter wheat cv. Sultan. The data concerning weather course were taken from the standard climatological station in the same site. Two years, 2011 and 2013, with different course of temperature were taken for evaluation.

Air temperature and humidity measurement

Data recording for winter wheat was conducted by means of a mobile climatological station equipped by digital temperature sensors (Dallas semiconductor, DS18B20 type) placed in the radiation shield. The recorders were positioned at three levels (on the ground, at the effective height of plants and at 2 meters above the ground) in order to cover the whole vertical profile. Sensors positioned at the effective height were moved up as the crop was growing. The effective canopy height is the height corresponding to approximately 90 % of the actual canopy height.

Data analysis

The spring vegetation period of winter wheat was divided in three stages: I – tillering to beginning of stem elongation, II – stem elongation to the end of flowering and III – development of fruit and ripening. Values from the above the ground vertical profiles were evaluated by the method of triangulation with linear interpolation and graphically displayed in the form of temperature isotherms by the Surfer ver. 8.03 (Golden Software, Inc. program.

RESULTS

As it can be seen from the Fig. 1 the course of air temperature was significantly different in particular years, and it influenced the length of developmental stages, too. The average temperature in developmental stages I were 11.8 °C in the year 2011 and 13.6 °C in the year 2013, for stage II 17.2 °C and 16.7 °C and for stage II and 19.7 °C and 19.8 °C, respectively. From these data is clear, the length of particular stages were influenced by the course of temperature rather than by average values.

The stratification of air temperature in winter wheat stands in particular developmental stages reflected the different courses in 2011 and 2013 years. As it can be seen from Fig. 2, the highest temperature were determined at 2 pm GMT+1 in the height 2 m and the differences were pronounced at the same time. They were dependent on the wheat developmental stages, too. In the stage I these diferrences between temperature measured in 2 m and on the ground were about 2 °C in the year 2011 and about 3 °C in the year 2013; in stage II 5 °C and 3 °C

respectively; and in stage III 5 °C in both years. On the other hand, the lowest temperature were measured at 5 am GMT+1 in the active height of wheat stand and they were about 1 °C lower in comparison with height 2 m.

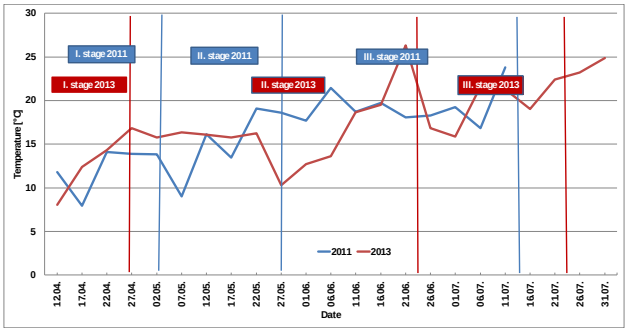
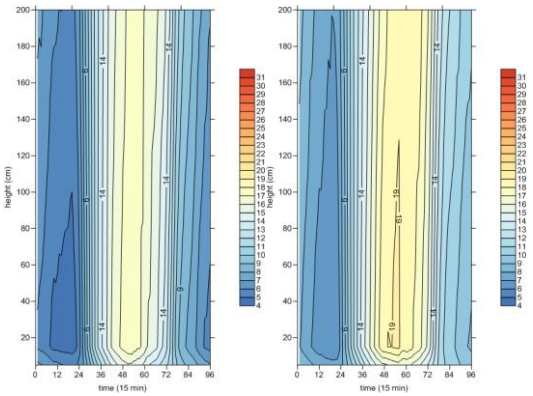
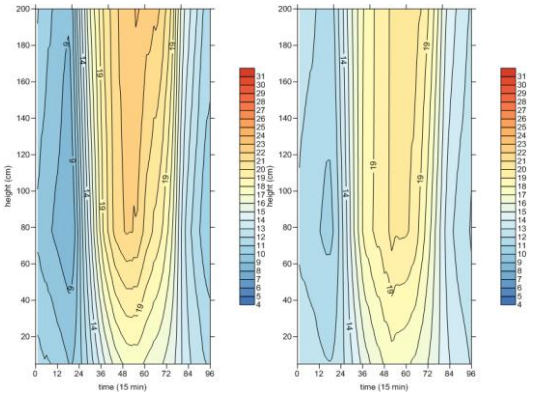


Fig. 1 The course of air temparature in pentade averages and lenght of particular wheat developmental stages in the 2011 and 2013

Stage 1



Stage 2



Stage 3

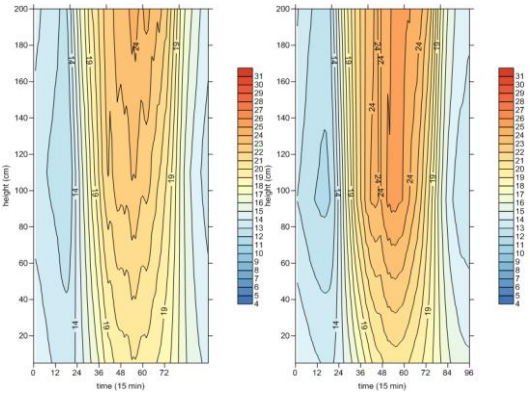


Fig. 2. Mean values of air temperature in vertical profile of winter wheat stand in particular stages – on the left - year 2011; on the right – year 2013

CONCLUSION

The vertical stratification of air temperature was determined in winter wheat stand during spring vegetation period in the years 2011 and 2013 with different course of weather. The wheat stand microclimate differed significantly from this of their surrounding environments. The temperature was usually lower in the ground level and effective height in the wheat stand in the light period of the day. Temperatures are used in models of crops development and yield and in epidemiological studies of pathogens occurrence, so microclimate data from the crop should be taken in consideration.

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