Original Article

Considerations Concerning the Hyerarchisation of the Climatic Factors Affecting Irrigation of Football Field from the Arieşul Turda Municipal Stadium

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Abstract

The most important problem of the arrangements and maintenance of the football playing facilities involves a series of aspects. In this context, climatic conditions represent an important issue. Our experimental demarche was developed in the climatic conditions of the Arieşul Municipality Stade located in the Municipality of Turda, County of Cluj. The experimental period was the time interval 2014 and 2015, and April and September 2014 – 2015. The data were statistically processed using the STATISTICA package v 8.0, for Windows. The multiple regression approach was used in data analyze. The multiple correlation (R = 0.654) between all three considered climatic factors affect the irrigation regimen in a manner directed by strengthens of the interaction between them, medium to strong, respectively.

Keywords: atmospheric humidity, temperature, rainfall regimen, multiple regression.

1. Introduction

The problem of the arrangements and maintenance of the sportive facilities, generally speaking, and of those destined to football playing, in particular, involves a series of aspects. The most important of these aspects, concern the facility management [1, 3, 4].

Here, we have to mention that these are conditioned by a multitude of input factors, among which, we have to mention: field placement, field destination (type of sportive activity, which it has to serve), and not at last, the pedo-climatic conditions of the placement area [2, 6, 7].

Thus, in present study, due to the already emphasized importance of the climatic conditions, in the context of placement and functioning of a football field, we took into consideration the interactions between the climatic factors temperature, rainfall regimen, and atmospheric humidity.

2. Material and Method

The trial was developed in the climatic conditions of the Arieşul Turda Municipal Stadium located in the Municipality of Turda, County of Cluj. Turda is located on the left side of the Arieş River.

It is characterized by the following coordinates: 46°34'15"N and 23°46'45"E, and 315 m altitude.

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The town lays in the vicinity of the Slăninii Hill, on the North-East side, and Vineyard Hill in West, which is a prolongation of the Cetăţii Hill (Fig. 1). The Arieşul Turda Municipal Stade from Turda, is located on Stadium Street, and has a capacity of 10,000 places. This area is characterized by dry climate. For this reason, the irrigation is a limitative condition, in order to deliver appropriate conditions, for an appropriate turf functionality in the above mentioned climatic conditions. Climatic data were partially recorded in situ, and partially obtained from local authorities.

Figure 1. The Municipality of Turda, the County of Cluj [8]

The experimental period was the time interval 2014 and 2015, and particularly between April and September in each year, interval that corresponds to the vegetation period characteristic for turf species used in this case, *Lolium perenne* and *Poa pratensis*, respectively.

The data were statistically processed using the STATISTICA package v 8.0, for Windows. In order to estimate, in dynamics, the interaction between the climatic factors, with potential influence upon the implementation of the irrigation systems for the stadium turf, temperature (t), rainfall regimen (Pp), and atmospheric humidity (H), respectively, the methodology of "multiple regression" was used [5]. In this case, besides the graphical representation of the above mentioned interrelationships, using answer areas, the intensity of the multiple correlation (R) and the determination coefficient

(R^2), at the interval of confidence of 95%, were also calculated.

Results and Discussions

During the time interval corresponding to the years 2014 – 2015, the interaction: temperature – rainfall regimen – atmospheric humidity in the Municipality of Turda, is moderate correlated. This assertion is sustained by the value of the coefficient of multiple correlation, R = 0.506, in this case, the analyzed variables are conditioning one to each other in a proportion of 25.60% (Fig. 2).

Thus, the increase of temperature contributes to the increase of the atmospheric humidity, while the rainfall regimen, negatively influences, but at low extent, the increase of the atmospheric humidity (Fig. 2).

The atmospheric humidity under 69% is reported for two temperature intervals, 9.6 – 9.9ºC characterized by a rainfall regimen of 7.25 – 75.6 mm, and 10.1 – 10.2ºC characterized by a rainfall regimen of 7.2 şi 7.45 mm (Fig. 2).

$$H\ (\%) = 29.459 + 0.198t\ (°C) - 0.044Pp\ (mm)$$
$$R = 0.506,\ R^2 = 0.256$$
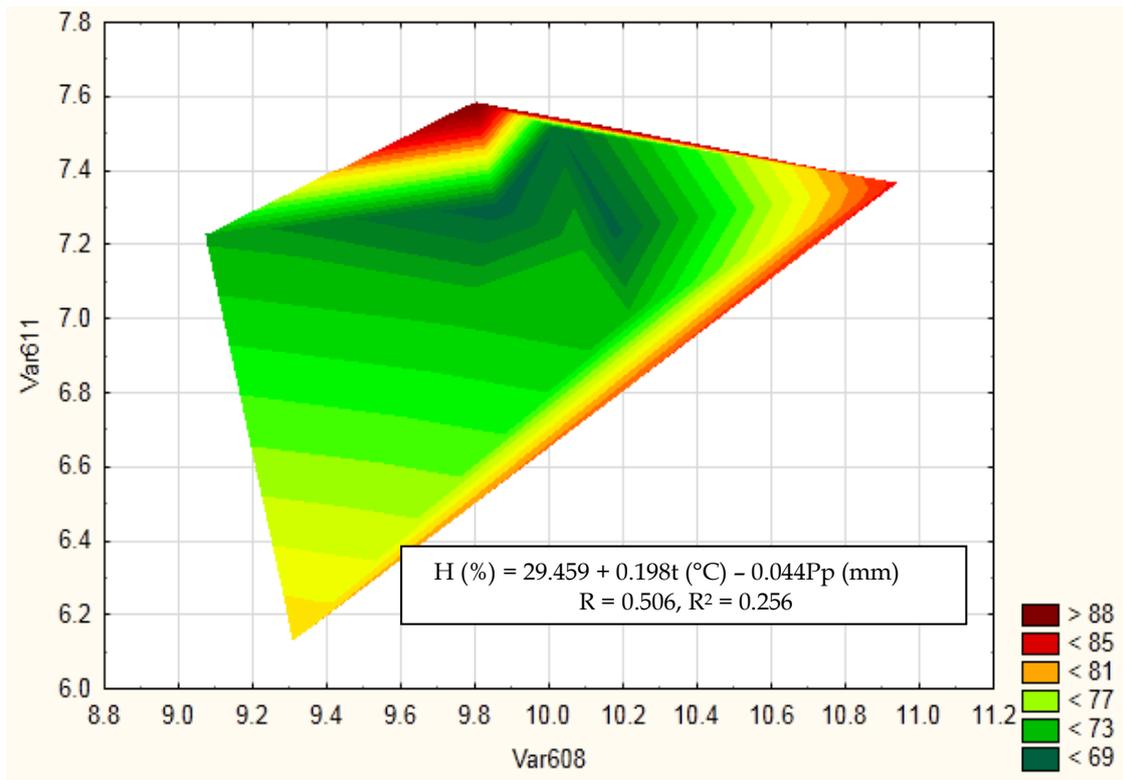
Var 608 – mean temperature, 2014 - 2015 (ºC); Var 611 – mean rainfall, 2014 - 2015 (mm)
R - the coefficient of multiple regression; R^2 –the coefficient of determination

Figure 2. The interaction between the climatic factors temperature – precipitations – atmospheric humidity, during 2014 – 2015, in Turda Municipality

We also mention that atmospheric humidity over 69% and under 88% are reported for three temperature intervals, respectively:

- ☞ the interval of 9.18 – 10.2ºC characterized by the rainfall regimen within the values 6.18 – 7.2 mm;
- ☞ the interval 9.18 – 10ºC characterized by the rainfall regimen within the values 7.2 – 7.5 mm;
- ☞ the interval 10.3 – 10.6ºC characterized by the rainfall regimen within the values 7 – 7.4 mm (Fig. 2).

During the experimental period corresponding to the vegetation period of the turf species composing the "green carpet" of the football field, *Lolium perenne* and *Poa pratensis*, the time interval April – September 2014 – 2015, respectively, a moderate to strong interaction is reported between the climatic factors: temperature, rainfall regimen and atmospheric humidity.

This interaction is explicitly defined by the value of the coefficient of multiple regression (R = 0.654). The variables are reciprocally influenced in a share of 41.90%. Here, we have to mention that atmospheric humidity has values over 76% during different intervals of temperature and precipitations (Fig. 3).

These correspond, on one hand, to temperatures between 12 – 15ºC and rainfall regimen between 0.7 – 3.0 mm. On the other hand, these correspond to a narrower temperature interval between 18 ºC and 19ºC, and precipitation supply within the value interval of 1.17 – 3.0 mm (Fig. 3). Atmospheric humidity under 59% are reported within the temperature interval 9 – 10ºC and rainfall regimen between 0.62 – 0.95 mm (Fig. 3).

According to our study, we also report, in experimental site, atmospheric humidity over 59% and under 76% for the following temperature and rainfall regime intervals:

- ⚽ the interval 10 – 15ºC characterized by the

rainfall regimen within the values 0.65 – 2.8 mm;

☞ the interval 12 – 20ºC characterized by the rainfall regimen within the values 0.9 – 2.7 mm;

☞ the interval 19 – 21.8ºC characterized by the rainfall regimen within the values 0.9 – 3.2 mm (Fig. 3).

If we take into consideration the analyzed period, the time interval within the months April and September of the years 2014 and 2015, the regression line indicates a positive contribution of both atmospheric temperature and rainfall regimen (with the same order of magnitude) to the increase of the atmospheric humidity (Fig. 3).
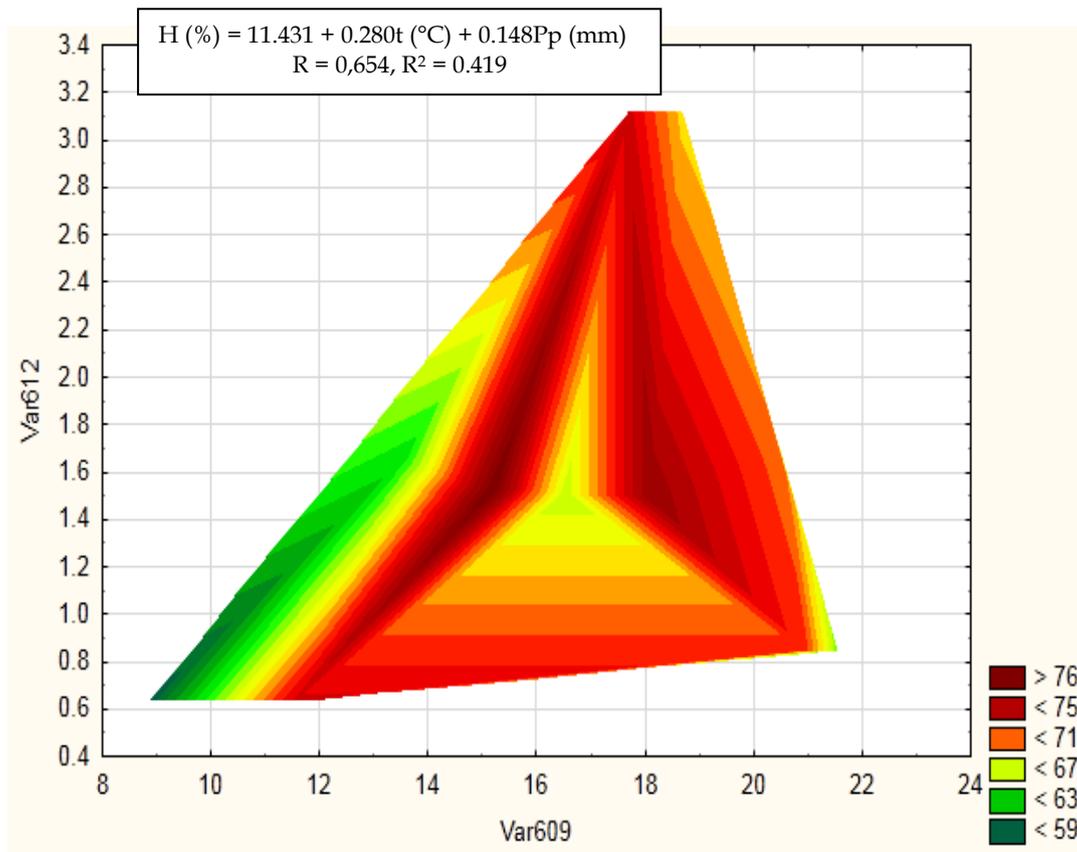
Var 609 – mean temperature, 04. - 09. 2014 – 04. - 09.2015(ºC); Var 612 – mean atmospheric humidity, 04. - 09.2014 – 04. - 09.2015 (%)
R - the coefficient of multiple regression; R^2 –the coefficient of determination

Figure 3. The interaction between the climatic factors temperature – precipitations – atmospheric humidity, during 04.-09.2014 – 2015, in Arieşul Turda Municipal Stadium

Conclusions

The interaction temperature – rainfall regimen – atmospheric humidity, considered for Turda Municipality is moderate correlated (R = 0.506) for the time interval 2014 – 2015, while if considered for the Arieşul Turda Municipal Stade, it is moderate to strong correlated (R = 0.654).

Our study shows a stronger correlation (moderate to strong in values) if considering a narrow time interval, months April – September 2014 – 2015, respectively, on a specific location, Arieşul Turda Municipal Stade, if compared to a

wider time interval, 2014 /2015, and location, entire Municipality of Turda, respectively.

These results show that all three considered climatic factors affect the irrigation regimen in a manner directed by strengthens of the interaction between them.

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