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TEMPORAL PECULIARITIES IN ENVIRONMENT FACTORS CHANGE AND IN PHYSIOLOGICAL DYNAMICS OF THE INDOOR PLANTS DURING LOW SOLAR ACTIVITY

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Abstract. The long-term time-course of some environmental meteorological factors and physiological characteristics of indoor *Marantha leoconeura* and *Ctenanthe setosa* plants cultivated under controlled lab conditions were investigated during the months of low solar activity of current solar cycle. The two weeks cycles, circaseptan and circasemiceptan cycles in natural factors change as well as in plant multi-diurnal physiological dynamics were revealed. The results points out on the cosmic provenance of the found rhythms.

Introduction

The long-term seasonal monitoring of environmental factors: PAR, UV radiation, temperature, atmospheric pressure and humidity was conducted simultaneously with outdoor northern arboreal wild and cultivated trees and some indoor plants as well since 2013th to 2020th years. The special attention we have paid to current months of low solar activity. The observations show that photosynthetic and other physiological plant functions were underwent both solar influence and the contemporary global climatic changes. The raised global temperatures might to enlarge the northern plant vegetative seasons but at the same time disturb their normal winter dormant functions and provided high humidity to promote the mass fungi diseases. Nevertheless, the cosmic factors show explicit influence on northern flora despite rather changeable terrestrial environmental factors, which was corroborated by the revealed temporal structure of long-term dynamics among a number of plant physiological functions. Some such effects are considered here.

Methods and objects

The exogenous photosynthetic active radiation (PAR), solar UV radiation, temperature, humidity were measured with portative "TKA-PKM" apparatus, St-Petersburg, Russia and field fluorometer PAM -2100 «WALZ, Effetrich», Federal Republic of Germany.

The vascular decorative plants *Marantha leoconeura* "Facinator" and *Ctenanthe setosa* cultivated under lab controlled conditions were used. The leaf-petiole changeable angles of different leaf blades these plant species were measured twice and daily during noon and evening hours.

Results and discussion

The multi-annual mean temperatures presented here were obtained for the most prominent height of the town Apatity where the place of observations was situated. Since 2013th to 2017th the temperatures for the vegetative months were correlated with solar activity in terms of mean Wolf numbers, but later the new trends presumably related to global climatic changes began to prevail. The September year-to-year temperature means curve for the current solar cycle are presented at Fig. 1, where the unsteady annual changes since 2017th one can see.

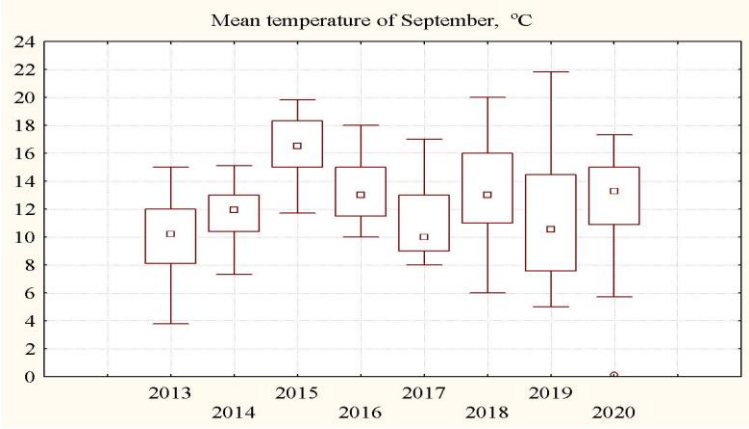

Figure 1. The September diurnal temperature at Apatity observation point for the current solar cycle. The square means median, rectangular 25-75%, bar – non outlier range, respectively.

Meanwhile, in parallel with decrease of annual solar activity the recurrent cycles among a number both environmental factors and among some plant physiological properties were observed. As an explicit feature of long-tem multi-daily time course was appearance of cycles presumably related to Solar-Earth magnetic field sector structure [*Breus et al.*, 1989, 1995].

The most robust cycles registered were as follows: circaseptan and circasemiceptan, the cycles about 14-days long, as well as a number of more prolonged periods were found also. The robust 27-day recurrent cycles or near so ones were registered in indoor plants since summer of 2017 yr up now. The advanced plant reactions with two temporal gap classes: shot-term (2-3 days) and long-term (6-8 days) ones on the eve of the large-scale Solar mass injections in 2017-2018th yrs were registered as well [*Kashulin et al.*, 2018].

The daily dynamics of exogenous atmosphere UV radiation for the 2020th vegetative season showed the presence both circasemiceptan and circaseptan components, Fig. 2.

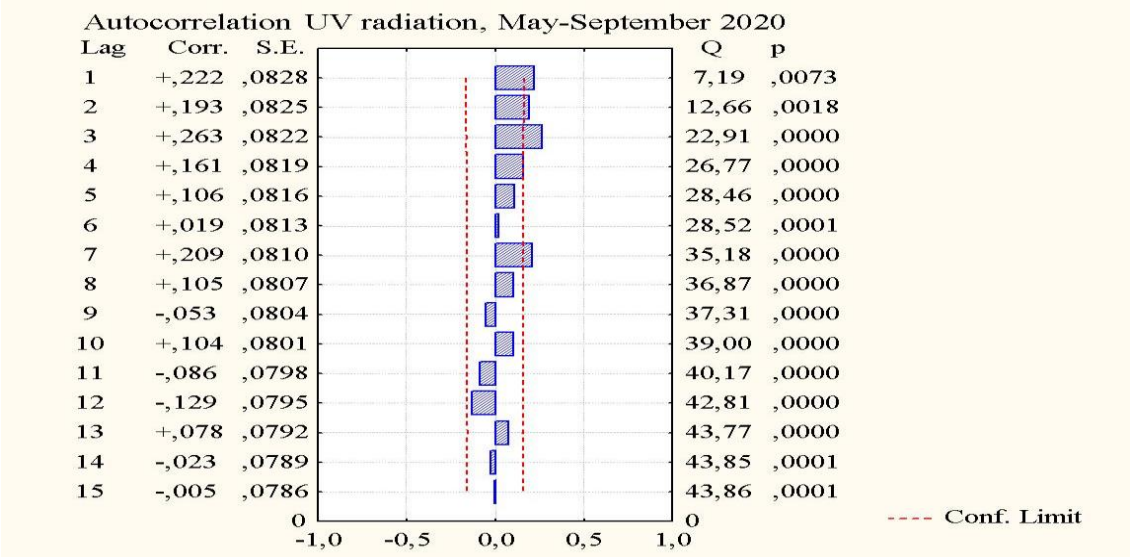

Figure. 2. Autocorrelation function for the diurnal exogenus UV radiation run in Apaptity during vegetative season of 2020th.

The circasemiceptan cycles in atmosphic PAR time-course for this vegetative season were revealed also, Fig. 3.

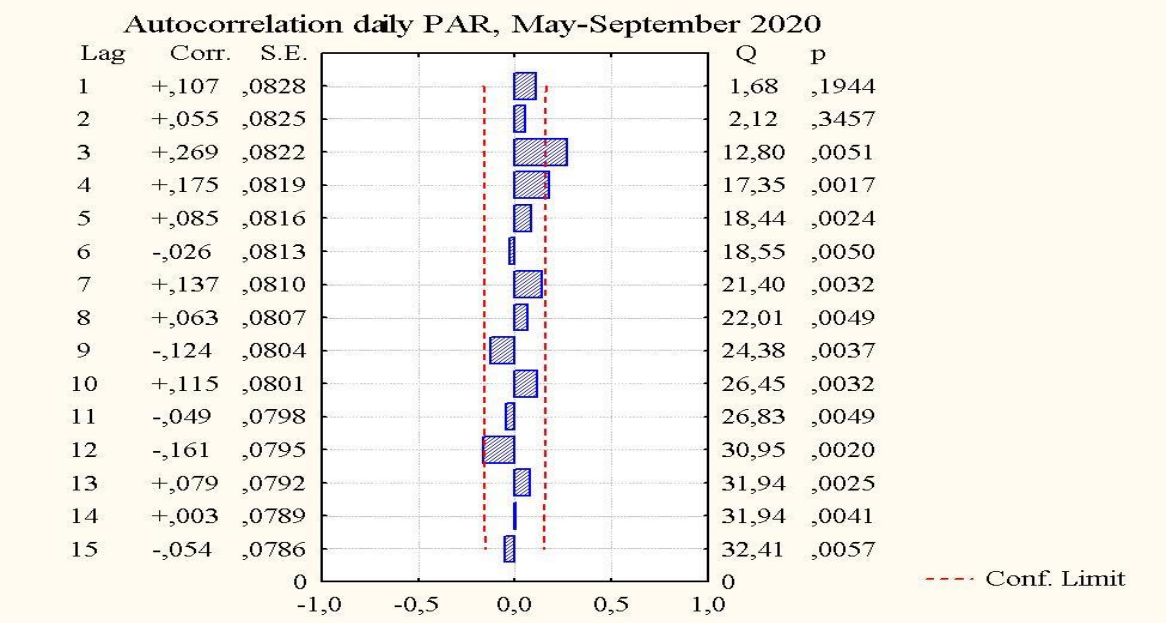

Figure. 3. Autocorrelation function for the diurnal PAR radiation run in Apaptity during vegetative season of 2020th.

The analogous cycles were revealed in multi-diurnal time-course in leaf-petiole angle daily rhythms for *Marantha leoconeura* "Facinator" Fig. 4 and *Ctenanthe setosa* Fig. 5 indoor plants. The species are widely considered as "living biological barometer" due to their important properties to response on abrupt atmospheric pressure and humidity changes via special barosensitive cells in the leaf blade petiole. In results of the time-course of leaf-petiole angle change for *Maratha* plants measurements have been demonstrated circaseptan and circasemiceptan cycles during the summer. For *Ctenanthe* plant the same rhythms and supplement two week leaf position cycles as well in winter months were revealed, Fig. 5. At the Fig. 4-5 the time-course for a definite single leaf for both plants are presented. The analogous dynamics were found for other leaf blades also. As a whole, the 5 different blades for every of three plants were observed.

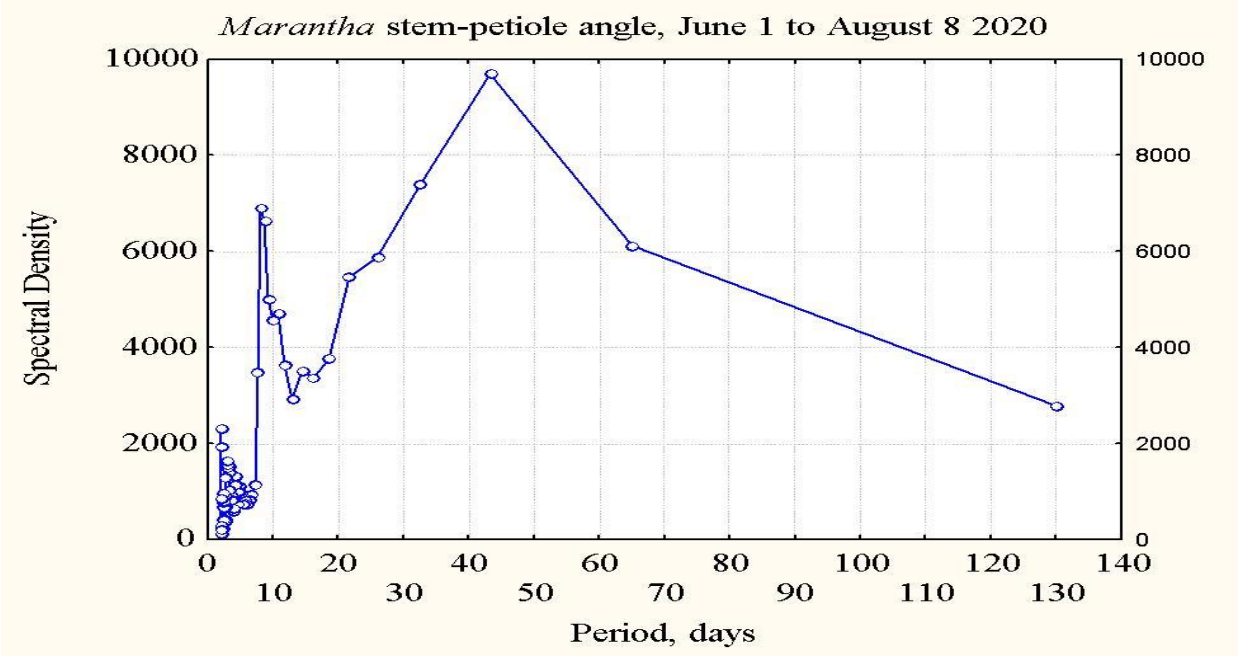

Figure 4. *Marantha leoconeura* stem-petiole angle multi-daily time-course run for the one selected leaf.

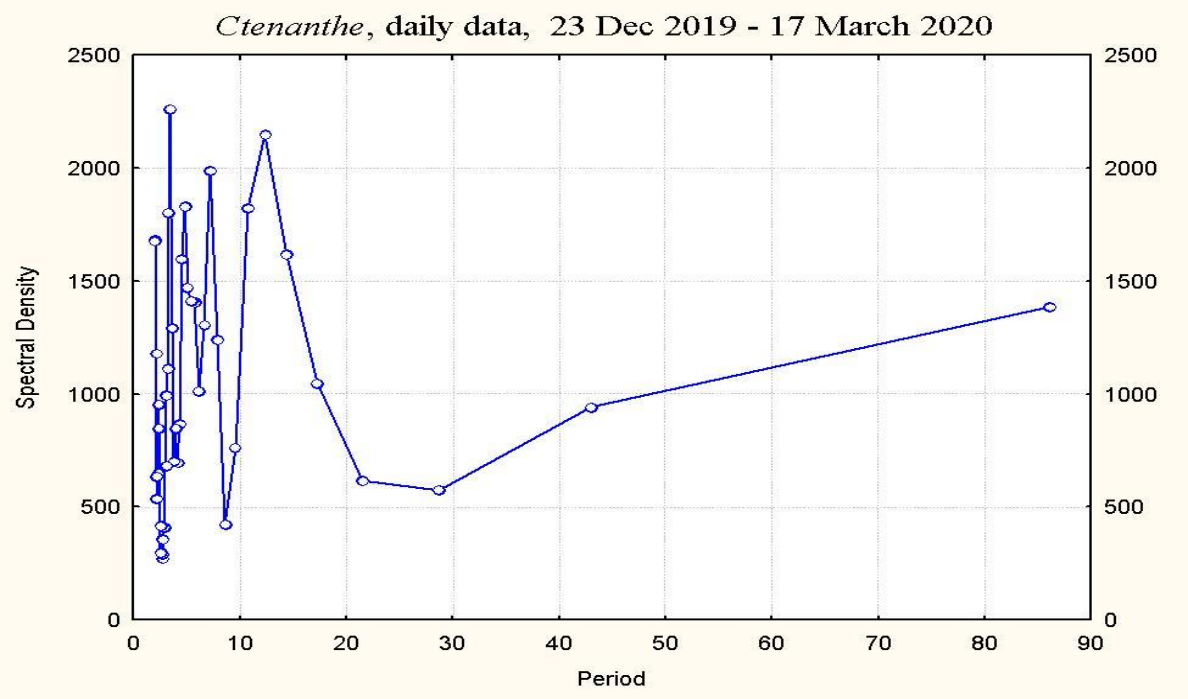

Figure 5. *Ctenanthe setosa* stem-petiole angle multi-daily time-course run for the one selected leaf.

The considered reccurent changes of various environmental factors and terrstrial climatic parameters point out on their exogenus, presumably cosmic modulatin and rhythm driving. The results obtained are in accordance with [*Dubov and Khromova,* 1992] that the recurrent changes of physical solar-terrisrial agents most expected for the calm solar years. The circaseptan and circasemiceptan cycles found might be drove either environmental terrestrial factors or cosmic ones also. To reveal the driving factors of multi-diurnal plant rhythms in this work the special attention was paid to indoor plants cultivated under controlled lab conditions, including photosynthetic radiation, UV radiation and temperature. Nevertheless, the plants used and physiological properties considered in the paper point out on the presence of driving pace-makers of exogenous cosmic provenance which able to modulate their rhythms and control their multi-diurnal dynamics. The experimental corroboration of the biological activity of the model magnetosphere changes on plant organisms cultivated under lab controlled conditions [*Kashulin and Pershakov,* 1996] was shown earlier.

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