RESEARCH ON THE PHYSIOLOGY OF SPRING PLANTS THAT INHABIT OAK FORESTS

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ABSTRACT

The paper presents the results of the research carried on the physiology of the spring plants belonging to the following species: Ficaria verna, Gagea lutea, Anemone ranunculoides, Scilla bifolia, Corydalis cava.

The physiological indices which have been analyzed were: photosynthesis, transpiration, total water content, free and linked water, osmotic pressure and suction force.

There were recorded increased values of transpiration, a high content of total water, a low percentage of linked water and low values of osmotic pressure at all the plants which have been studied.

The low temperature of the soil during the flowering period of these plants does not influence the normal activity of the roots.

*The defoliated forest allows for the sun's rays to penetrate to the ground level, but the values of photosynthesis do not increase in p*roportion to the intensity of the light, remaining relatively constant until the evening.

INTRODUCTION

A large number of spring ephemeral plants appears in the defoliated oak forests during this period of the year time.

These often form a compact vegetable carpet, their growth being favored by the sufficient quantity of water from the soil and the sunlight passing freelytrough the empty branches of the trees.

In the spring of 2019, physiological determinations were made in the Ceringani forest in Mehedinti county, Romania.

The forest is located on the Ceringan Hills, at an altitude between 130-347 m, the coordinates being 44^0 $39^{'}$ latitude and $23^0 14^{'}$ longitude (Sirbu Anca, 2007).

This area is a component part of the Motru Piedmont and is placed to the left of the Motru river and west of the Ceringani locality.

The climate is continental temperate, with slight sub-Mediterranean influences.

The precipitation regime during the winter period favors the growth and development of plants that emerge in the spring throughout this area.

This area contains a taxon threatened at European level (*Typha shuttleworthii)*, an endemic and threatened taxon at European level (*Eritronium dens-canis*) and 24 other taxa

included in the Red List of Romania (Oltean et al, 1994).

Due to the fact that in the researched area the shading of the herbaceous species occurs quite late, in mid-April or even on the beginning of May, as it was the case in 2019, makes these plants benefit from full direct sunlight.

These, having an ombrophilous character, can only use 10-20% of the direct sunlight.

Coexisting on a restricted growing space, a process of competition is established between plants for water and food sources.

Therefore, many of these species become invasive, in the detriment of rare species, such as *Eritronium dens-canis*, present in the area.

As all the spring plants have similar characteristics regarding the physiological processes, the data obtained for the studied species can be attributed to the rare species, on which, for protective reasons, have not been made determinations.

These determinations involved breaking the leaves, roots, or even complete damage to the plants.

MATERIALS AND METHODS

For the study of the physiological processes and of some parameters, determinations were made on the species:*Ficaria verna, Gagea lutea, Anemone ranunculoides, Scilla bifolia, Corydalis cava.*

Photosynthesis and transpiration were determined with the portable Lci apparatus.

The total water content was determined gravimetrically by drying the plant material at the oven at 105 ^{0}C.

The water forms (free and linked) were determined by the Artihovski method(Boldor O., 1983).

The suction strength of the parenchyma was determined by immersing equal portions of leaves in solutions with different concentrations of sucrose and determining the isotonic solution (Boldor O., 1983).

The osmotic pressure of the cell juice was determined using the plasmolytic method.

Scilla bifolia L. 10-25 cm high, upright, with mostly 2 linear-lanceolate, 3-10(-15) mm wide stem leaves with a hooded tip. Inflorescence with 2-9 flowers, terminally placed.

Flowers blue, rarely pink or white, upright.

Leaves in number of 6, placed around the stem in a star fashion, narrow-oval, 6-12 mm long. Stylus 1.

Fruit a 3-fan, spherical capsule with 1-2 seedsin eachcompartment.

(https://www.infoflora.ch/en/flora/scilla-bifolia.html).

***Anemone ranunculoides L*.** Perennial herb. Rootstock long, creeping, brown, with runners. Height: 7–30 cm (2.8–12 in.). Stem unbranched, glabrous at base.

Flower: Perianth regular (actinomorphic), yellow, 15–30 mm (0.6–1.2 in.) wide. Tepals 5, outer surface hairy. Stamens many, yellow. Gynoecium separate, with many pistils. Flowers 1 or 2, rarely more.

Leaves: Basal leaves 1, long-stalked, 3–5-lobed, large-toothed, hairy-edged. Stem leaves in a whorl of 3, short-stalked. Blade with 3 leaflets; leaflets quite narrow, pinnatifid–large-toothed.

Fruit: Hairy, short-tipped, 3–4 mm (0.12–0.16 in.) long achene, forming a cluster. Infructescence erect.

(http://www.luontoportti.com/suomi/en/kukkakasvit/yellow-wood-anemone).

***Gagea lutea*,** Yellow Star-of-Bethlehem, Liliaceae family

Growing form: Perennial herb. Bulb solitary.

Height: 10–20 cm (4–8 in.). Stem unbranched.

Flower: Perianth regular (actinomorphic), yellow, outside greenish, approx. 2–3 cm

(0.8–1.2 in.) wide.
Tepals 6 in 2 similar whorls, blunt-tipped, glabrous. Stamens 6.
Pistil of 3 fused carpels, stigma green. Inflorescence a 1–7 flowered umbels.
Leaves: Basal leaves 1(–2), stalk short. Blade 5–10 mm (0.2–0.4 in.) wide, linear, grooved, bow-tipped, with entire margins, glabrous, parallel-veined, dark green–bluish green. Base of inflorescence usually with 2 leaf-like subtending bracts.
Fruit: Bristly, loculicidal (3-parted), thin-walled capsule.
(http://www.luontoportti.com/suomi/en/kukkakasvit/yellow-star-of-bethlehem)

Ficaria verna – *Ranunculaceae* family; is a short (up to 12 in. [30.5 cm]), herbaceous perennial that invades forests throughout the East, Midwest and Pacific Northwest regions of the United States.
The basal leaves are dark green, shiny, kidney to heart-shaped and vary greatly in size.
Flowering occurs in March and April when showy, bright yellow, eight-petaled flowers develop on stalksabove the leaves.
Flowers are up to 3 in. (7.6 cm) wide.
The fruit are achenes that are pubescent. It also reproduces with bulblets and tubers.
Ficaria verna invades moist, forested floodplains. It is a spring ephemeral and grows vigorously, creating dense mats that exclude all other vegetation.

It is a threat particularly to the native forest springephemerals that have to compete for light and space with this invasive species. The plant is native to Europe.
(https://www.invasiveplantatlas.org/subject.html).

Corydalis cava L Schweigg. & Körte (syn. *Corydalis bulbosa* Pers.) family*Papaveracea;*is a woodland plant native to Europe and western Asia. (https://www.pacificbulbsociety.org/pbswiki/index.php/Corydalis_cava)

Corydalis cava is a perennial growing to 0.2 m (0ft 8in) by 0.1 m (0ft 4in). It is hardy to zone (UK) 6.

It is in leaf from March to June, in flower from February to May.

The species is hermaphrodite (has both male and female organs) and is pollinated by bees.

Suitable habitat: light (sandy) and medium (loamy) soils and prefers well-drained soil. Suitable pH: acid, neutral and basic (alkaline) soils. It can grow in semi-shade (light woodland). It prefers moist soils.
(https://pfaf.org/user/Plant.aspx?LatinName=Corydalis+cava).

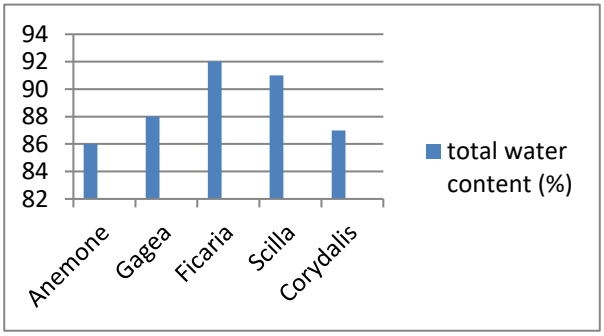
RESEARCH RESULTS

The water content of leaves

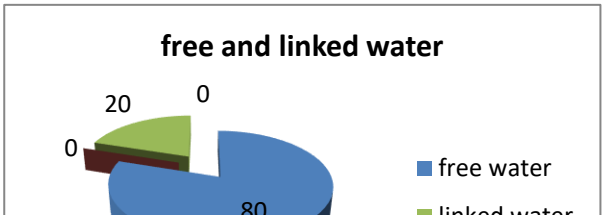
The water content of the leaves registered high values, of over 85%, according to graph 1.

These values are due to the sufficient quantity of water in the soil;another factor is represented by the optimum absorption of the water even when temperatures average 7 ^{0} C at the soil level.

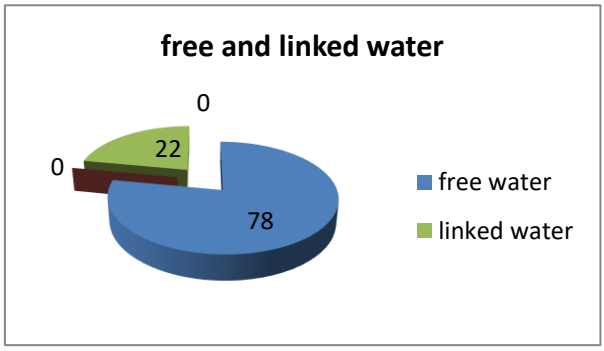
The percentage of free water is higher than that of linked water, but those about 20% of linked water can ensure the survival of plants in the periods of frost that occur frequently in spring, after these plants have sprung up (graph. 2-6).



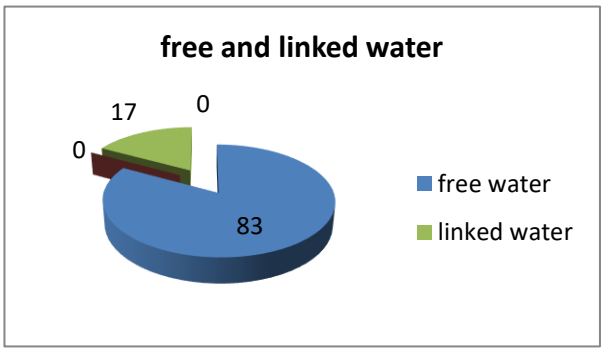
Graph. 1. The total water content of leaves(%)



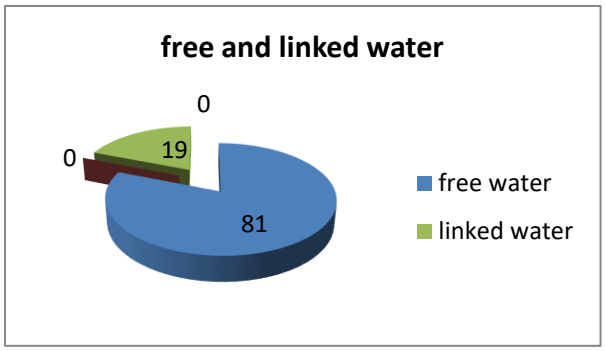
Graph. 2. The content in free and linked water at *Anemone ranunculoides*



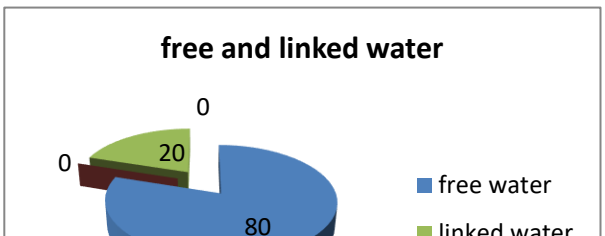
Graph. 3. The content in free and linked water at *Corydalis cava*



Graph. 4. The content in free and linked water at *Ficaria verna*



Graph. 5. The content in free and linked water at *Scilla bifolia*

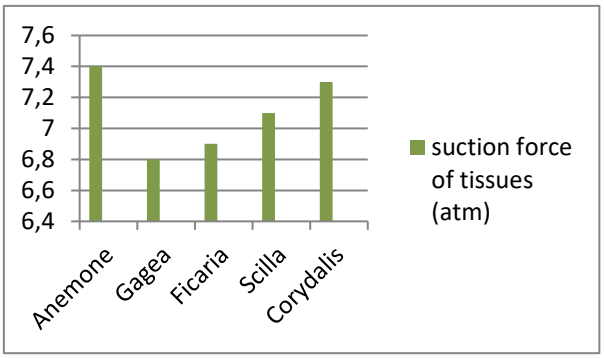


Graph. 6. The content in free and linked water at *Gagea lutea*

The suction force of the parenchyma

The suction force of the leaf parenchyma had values between 6-9 atm (graph 7).

These indicate that the osmotic pressure of the cellular juice has low values. In the conditions of good water supply and taking into account the low concentrationof the soil solution, high values of tissue sucction force levels are not necessary.



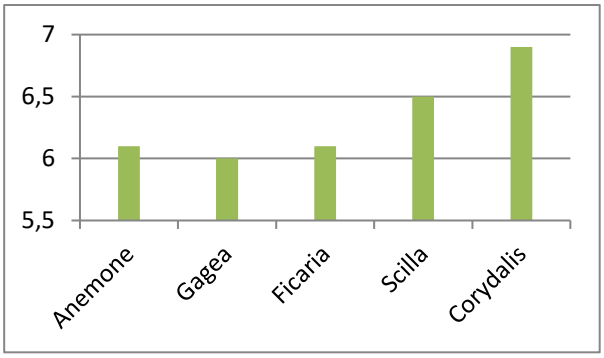
Graph. 7. The suction force of parenchyma

The osmotic pressure of celular juice

The osmotic pressure of the cell juice in the plants which have been taken into the study registered low values(as shown in graph. 8);t his is a consequence of the fact that these plants show a low

concentration of the cellular juice and a high water content.

These reduced values are not a disadvantage for them, because the soil, rich in water, has also low concentration values and thus, a reduced osmotic pressure.

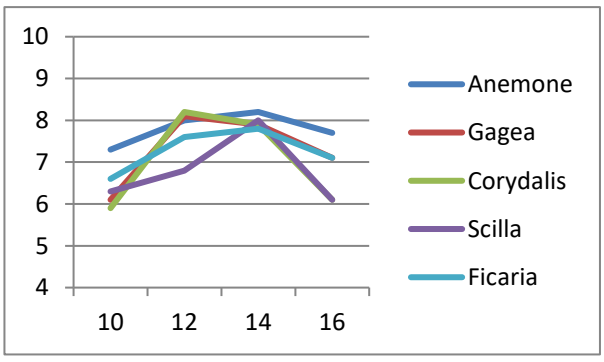


Graph. 8. The osmotic pressure (atm)

The intensity of transpiration

The intensity of the transpiration is maintained at high values throughout the day, with a maximum during noon at all species studied (graph 9).

The thin cuticle and the maximum opening of the osteole of the stomata favors the process of transpiration which, in turn, ensures the ascension of the raw sap by increasing the suction force of the leaves.



Graph. 9. The diurnal variation of leaves transpiration (mmol H 2O / m 2 / s)

Photosynthesis intensity

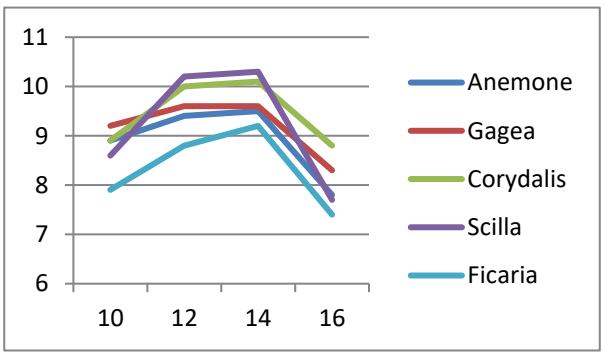
The diurnal variation of photosynthesis shows a maximum around 11 o'clock, after which it remains relatively constant until 16 o'clock (graph 10).

The direct sunlight increases the temperature at the soil level and thus should led to the intensification of the photosynthesis process; also, the maximum opening of the stomata, evidenced by the high values of the transpiration, favors the penetration of CO_2 at the leaf level.

If under these conditions photosynthesis does not increase, it means that intense light becomes a limiting factor.

This demonstrates the fact that the plant species which have been chosen for this study show an ombrophilous character, being able to efficiently use only a small percent of the direct sunlight received.

These observations are in concordance with data from the specialty literature which show that ombrophilous plants cand efficiently use only 10% of the direct sunlight, reaching a maximum photosynthesis intensity at a value of about 10.000 lux (Atanasiu L., 1984; Atanasiu L., Polescu L., 1988).



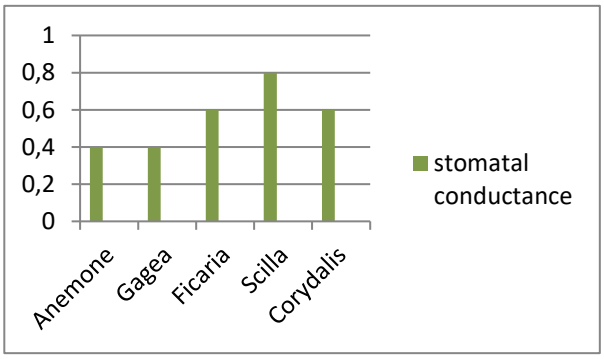
Graph. 10. The diurnal variation of photosynthesis (µmolCO2 /m2 /s)

The stomatal conductance

The stomatal conductance directly modifies plant water relations and photosynthesis. Many environmental factors that affect the stomatal conductance have been studied (Urban J et al, 2017).

Stomatal conductance, measured in mol m^{-2} s^{-1}, is the measure of the rate of passage of carbon dioxide entering, or water vapor exiting through the stomata of a leaf.

The obtained data (graph 11) show that all the plant species which have been taken into study show high values in the case of the stomatal conductance.



Graph. 11. The stomatal conductance (mol / m 2 / s)

This fact explains the high registered values of transpiration and photosynthesis.

CONCLUSIONS

In the research area, the precipitation regime during the winter period and the temperature favors the growth and development of plants that emerge in the spring

As a direct consequence of the thin cuticle of the leaves and also because of the fact that the stomata remain open all day, the spring ephemeral plants which have been taken into the study show high values in the case of the transpiration process.

The total water content of the leaves registers high values, between 86% and 92%.

Of the two forms of water (free and chemically linked), free water is found in a higher percentage in tissues (with an average of 80%).

The low temperature of the soil during the maximum development does not impede the normal activity of the roots.

The recorded values in the case of the osmotic pressure and of the suction force are reduced due to the large quantity of water from the tissues and the low concentration of cellular juice.

The stomatal conductance shows high values, favoring the process of water removal and the absorption of carbon dioxide, necessary in the case of photosynthesis.

The diurnal variation of photosynthesis indicates that these plants can only utilize 10- 20 % of the direct sunlight, they show a pronounced ombrophilous character**.**

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