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Cutting effects on water balance in the leaves of *Trifollium alexandrinum* L.

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RESUME – *"Effets des coupes sur l'équilibre hydrique des feuilles de* Trifolium alexandrinum*". Les effets des coupes sur l'équilibre hydrique des feuilles de* Trifolium alexandrinum *L. (cv. Lito) sont étudiés dans le but d'identifier le mécanisme de compensation de croissance. L'expérience est conduite dans une région semi-aride du Nord de la Grèce, dans un champ à fertilité du sol faible, sous irrigation. Les résultats montrent que les hautes valeurs du potentiel foliaire des plantes coupées, en dépit de leur haute conductance stomatique et leur transpiration, sont dues à leur abilité de préserver un haut potentiel foliaire. Cet équilibre hydrique favorable induit un haut niveau de production.*

Mots-clès : *Production, potentiel hydrique, conductance stomatique, transpiration,* Trifolium*.*

Introduction

Trifolium alexandrinum L. is an annual legume, with high productivity and also well-adapted to various environments and soil conditions. It is also known as a very good forage quality and it is recommended for Mediterranean region. During growing season 3-6 cuttings are recommended and that depends on the plant variety and management practices (irrigation or not) (Kontsiotou, 1984).

Water potential is linearly related to the plant production and furthermore, it is one of the principal parameters affecting the stomatal function. On the other hand, stomatal opening is the main factor determining the transpirational water losses and simultaneously the CO2 uptake. Thus, there is an indirect effect on CO_2 assimilation, photosynthetic rate and production (Kappen *et al.*, 1995).

Several investigations report that cutting or grazing increases photosynthetic rate as a consequence of increased stomatal opening and also the improvement of plant's water status (Pάez and Gonzάlez, 1995). The increased production has been also attributed to the improvement of water balance, aspect which is still under consideration.

The objective of this study was to identify the cutting effects on the productivity and on the water balance in the leaves of *Trifolium alexandrinum* L. (cv. Lito).

Material and methods

The experiment was performed in Drama (41°09΄ N lat, 24°09΄ E long, 130 m alt), in Northern Greece, where the climate is semi-arid, with mean annual temperature 15.2^{0}C, and mean total precipitation 589.4mm. The dry period is from the middle of June to September.

The soil was clay with pH value equal to 7.5 and uncultivated because of its low fertility.

The experiment was established in autumn 1995, with a sowing density of 4 g/m^2 for *Trifolium alexandrinum* L. cv. Lito, produced at the Forage Crops and Pastures Institute of Larisa, in Greece. All stands were well irrigated by sprinkler to maintain field capacity.

The applied treatments were two levels of cutting intensity: a) one cutting at the stage of full maturity (C0), b) cutting when the first inflorescence appears, about 20 days' time intervals, at height of 3 cm above the soil's surface (C3). The cut material was oven dried at 75°C for 48 hours and the total above ground biomass (production in g m^{-2}) was determined each time the plants were cut.

Stomatal conductance and transpiration rate were measured by a steady-state porometer (Li-1600 της LiCor Nebraska, U.S.A.), and midday leaf water potential by a pressure chamber (ARIMAD –2) in twelve leaves of each treatment (Koide *et al*., 1994). At the same time twelve leaves from each treatment were cutted for Relative Water Content (RWC) measurements. A disc of each leaf was placed in a sealed container with saturated atmosphere and then it was weighted. Thus the fresh weight (FW) was recorded. Afterwards, leaf discs were placed in distilled water for 10 h and the new weights were taken as turgid weight (TW). The discs were then dried at 80^0C and their dry weights (DW) were measured. The Relative Water Content was calculated by the formula:

RWC=(FW-DW/TW-DW)x 100 (Koide *et al*., 1994).

The experimental design was completely randomized, with field plot size of 1 m x 1 m, and four replicates.

Measurements were performed from April to July of the same year and they were repeated after 20 days' time intervals.

Results and discussion

Seasonal changes of leaf water potential, illustrated on Fig. 1, presented significantly higher leaf water potential in the cut, compared to uncut plants. The Ψ values ranged from 1.7 to 2.0 for the cut treatment and from 1.7 to 2.55 for the uncut one. Similar results were reported by many researchers in various species (Wolf and Parish, 1982). The low values of Ψ that were obtained in the uncut treatment could be attributed to the faster coming ripening (Noitsakis and Berger, 1984; Link *et al.,* 1990). Contrarely, the cutting kept the plants to the vegetative stage and this effect was accompanied by favour water potential. The higher values of Ψ appeared in the cut plants compared to uncut at the same values of relative water content (Fig. 2) could be attributed either to osmoregulation or to adjustment of cell wall elasticity (Larcher, 1995).

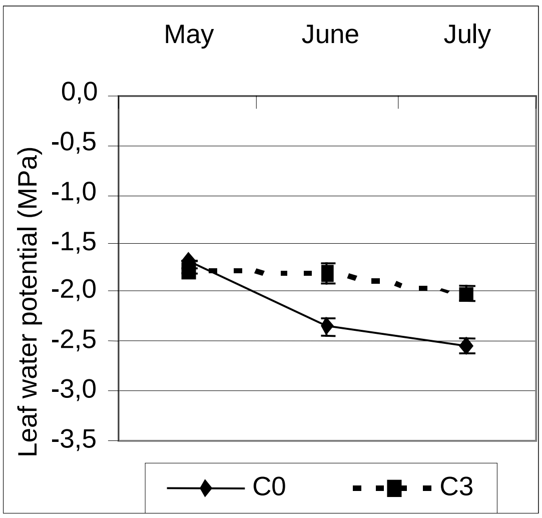

Fig. 1. Seasonal changes of leaf water potential, in cut (C3) and uncut (C0) plants of *T. alexandrium*.

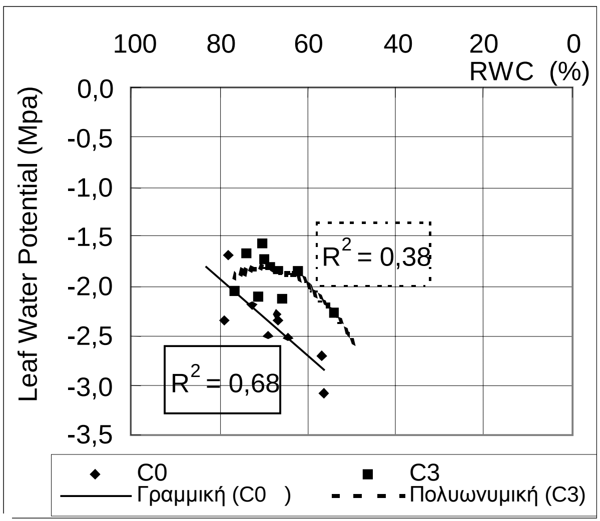

Fig. 2. Leaf Water Potential in relation to Relative Water Content, in cut (C3) and uncut (C0) plants of *T. alexandrium*.

Apparently the higher values of Ψ in cut plant induce a better water balance. Thus it may be assumed that the cut plant could present higher values of stomatal conductance and consequently higher transpiration rate. Indeed the stomatal conductance (Fig. 3) in cut plants was higher implying higher values of transpiration rate (Fig. 4). Besides the water potential, the profile of microclimate in cut plants might be related to water internal status (Kappen *et al*. 1995; Lazaridou, 2001).

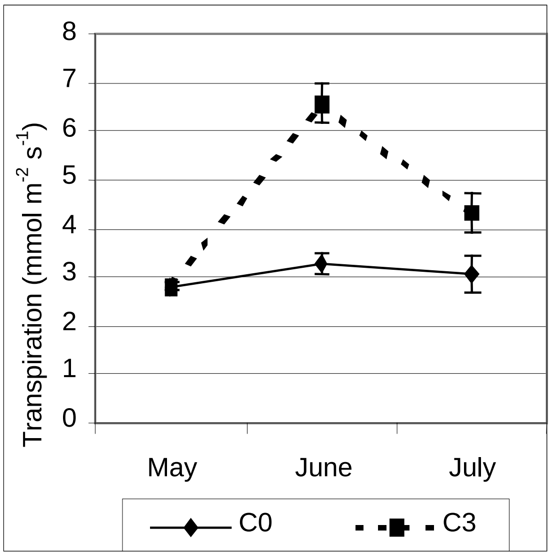

Fig. 3. Seasonal changes of Transpiration in cut (C3) an uncut (C0) plants of *T. alexandrium*.

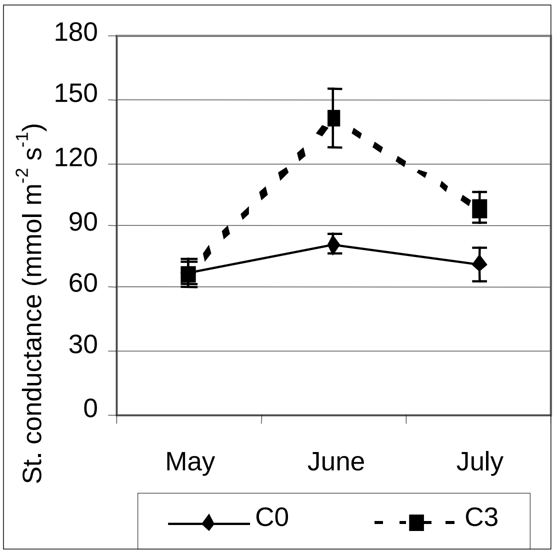

Fig. 4. Seasonal changes of Stomatal conductance in cut (C3) and uncut (C0) plants of *T. alexandrium*.

The ability of a cut plants to maintain high stomatal conductance is accompanied by an analogous CO_2 uptake and high photosynthetic rate. This fact in combination with favour leaf water potential could be resulted in high productivity (Grimes *et al*., 1992; Paez and Gonzalez, 1995). Indeed, the annual production of the cut treatment is 610.2 g/m^2, while in the uncut treatment it is only 335.5 g/m^2 (Table 1). Similar results are also reported by Kontsiotou (1984).

Table 1. Annual production of *Trifollium allexandrinum* cv. Lito

Treatment	Production (Kg/m^2)	Standard error
Uncut (C0)	335.5	3.96
Cut (C3)	610.2	68.01

Conclusions

The evaluation of cutting treatment on *Trifollium alexandrinum* suggest that the plants under cutting preserve higher leaf water potential in spite of their higher stomatal conductance and transpiration rate and present higher annual production compared to the uncut plants.

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