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LEAF SCALE PHOTOSYNTHESIS MEASUREMENTS IN MAIZE FIELD UNDER DIFFERENT FERTILIZATION ADDITION

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***Abstract**: Carbon dioxide (CO_2) fluxes between the surface and the atmosphere have large biological contribution. Photosynthesis is one of the largest of these fluxes. Components of the carbon balance are in close relationship with plant production, and eventually yield in agricultural vegetation. We examined photosynthesis of maize in the 2019 vegetation period in this study. The study site is a sowing time–fertilizer–maize variety field experiment near Martonvásár. This is a small plot experiment, where a treatment replicate consists only of two rows of maize i.e. a total of about 60-70 individual plants. Ecosystem scale micrometeorological measurements are not applicable in this type of setup and the only destructive examinations can be done upon harvest to avoid disturbance of the experiment in the vegetation season. We used non-destructive leaf scale photosynthesis measurement method (CIRAS-3, PPSystems, and Amesbury, MA, USA) regularly to explore temporal variations of assimilated CO_2 during the vegetation period. The sampling was designed to include several plants and leaves to optimize number of replicates. We selected five plants per row in five replicates (leaves). The methodology was applicable for determination of maize photosynthesis in the experiment. Light response and temperature response of photosynthesis agreed with our knowledge. We found that net photosynthesis rate of maize leaves have a well-defined profile in the vertical canopy as light and leaf age changes, which highlights the importance of repeated measurements in the canopy when planning regular observations.*

***Keywords**: Leaf scale, photosynthesis measurements, maize field, fertilization addition*

SITE DESCRIPTION, METHOD

Experiment of continous maize sowing date was done in four replicates with combination of four sowing dates. We focused on one variety (Mv Tarján), which is a very popular choice of Hungarian farmers. The last sowing date (beginning of May) combined with two constracting fertilizer treatments was selected, 60 kgN/ha and 180 kgN/ha. Measurements were carried out on the same five leaves, each examined plants, taken from bottom to top (Fig. 1). Timing of measurements was 8-11 AM in every occasion. A total of five measurement days was sucessful in the 2019 vegetation period.

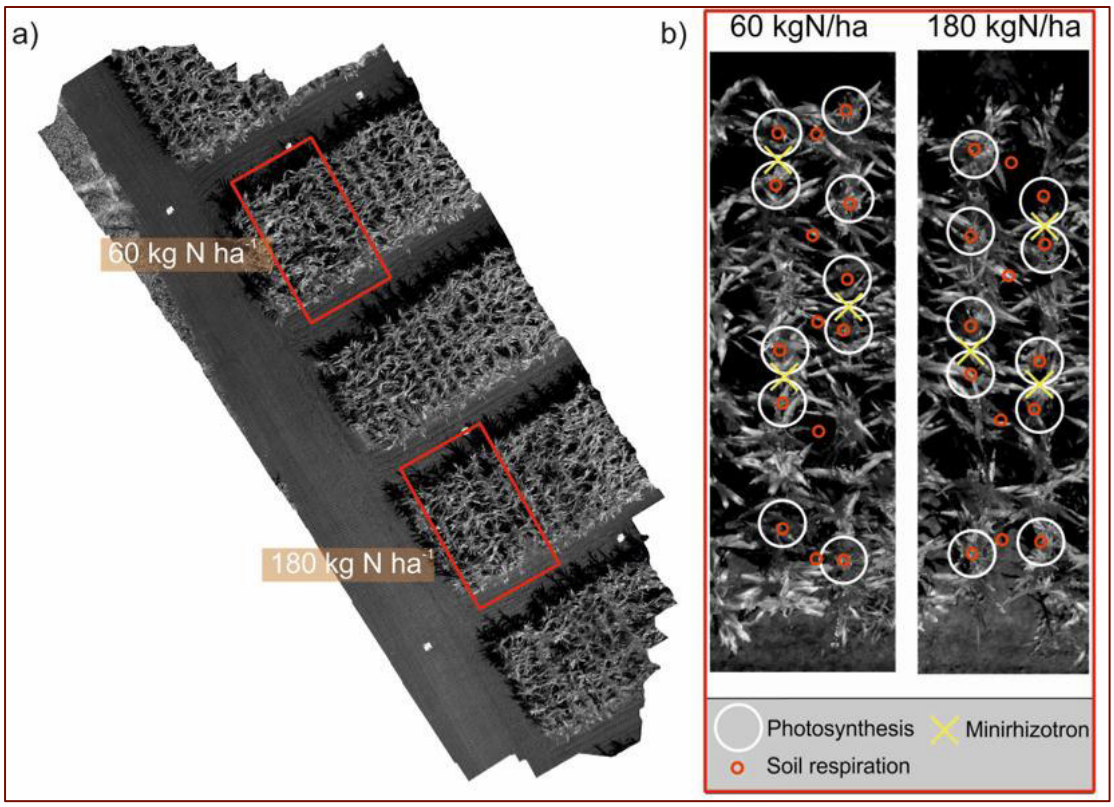
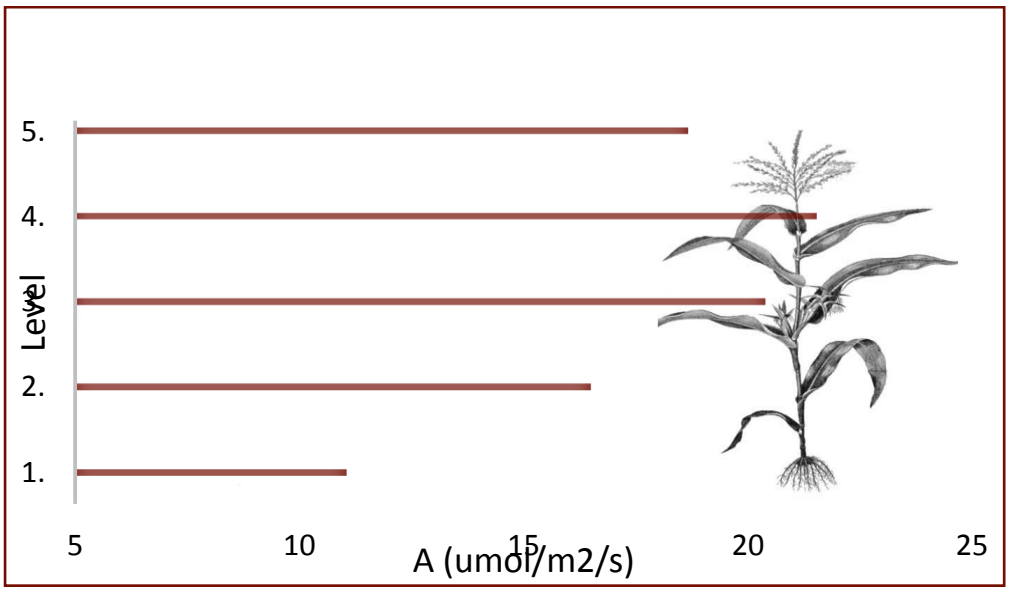


Figure (1) a.) ortophotograph of the experiment; b) Aerial photograph of he study indicating the photosynthesis (white circles) and other measurements as soil respirations (red circles) and installed minihizotron tubes (yellow X)

RESULTS

Results showed that generally lower leaves gave lower assimilation rates, but the value had a drop at the top layer as shown on Fig. 2. This finding was consistent in both treatments, every single plant.

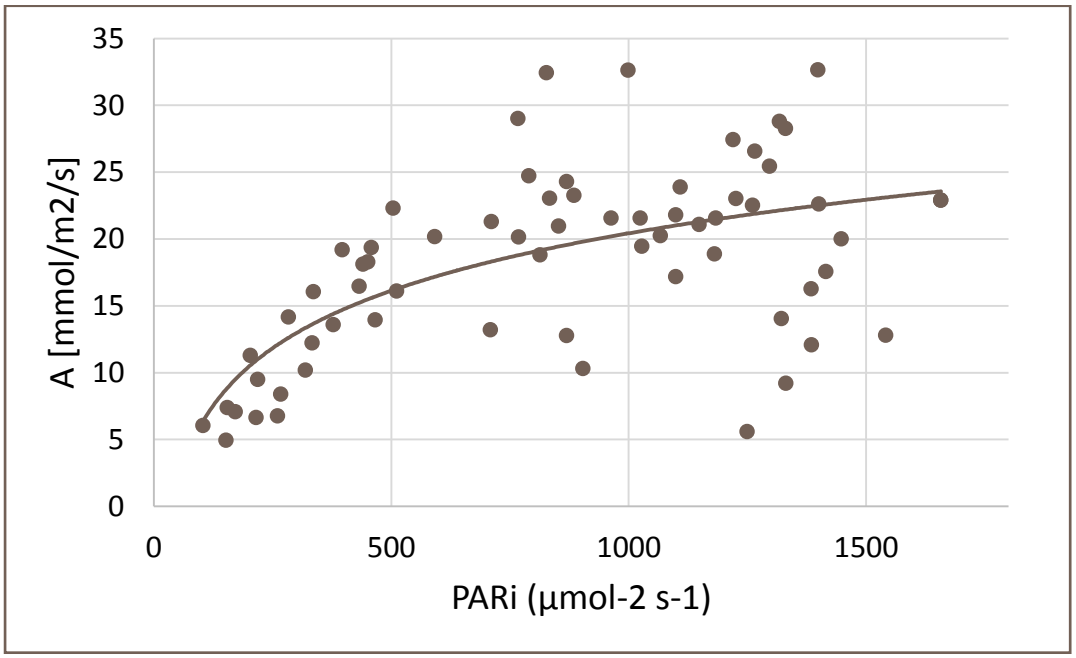


CO_2 assimilation in different levels, both treatements

Figure (2) Measured average CO_2 assimilations depending on the level of leaves from bottom to top

Light response curves (LRCs) provide indications of light saturated photosynthetic rate, quantum efficiency, and maximum photosynthetic capacity with examination of photosynthetic changes (A) as a function of

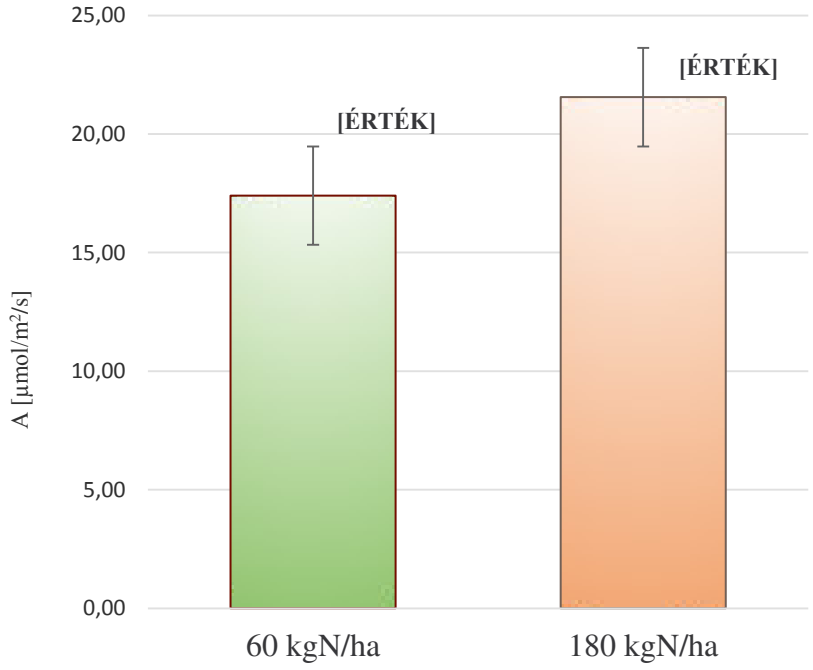
incident photosynthetically active radiation (PARi)



Light response curve

Figure (3) Relationship between net CO_2 assimilation and photosynthetically active radiation.

Comparing assimilation rates of the plants of both treatments separately showed us, addition of higher amount of Nitrogen can increase the photosynthetic production (Fig. 4). However, data dispersion was high in virtue of abiotic factors on measurement days (Fig. 5)



Average CO_2 assimilation levels in different treatments

Figure (4) Moderate assimilation levels in both treatments

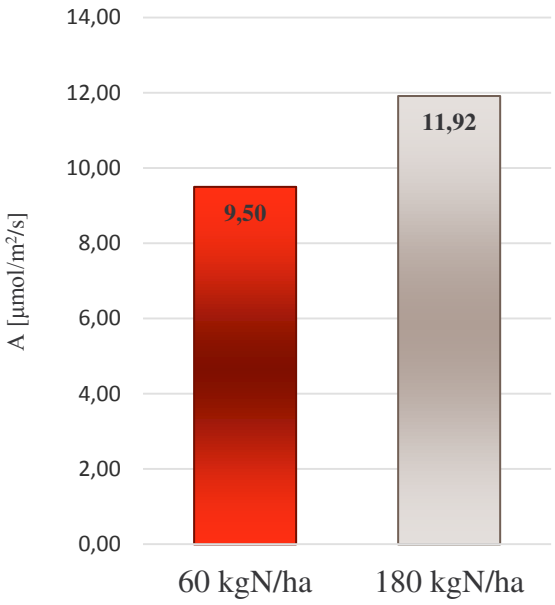


Figure (5) Data dispersion of CO_2 assimilation in both treatments

CONCLUSIONS

In the next step, simple photosynthesis models will be applied on the data to mathematically examine differences between the treatments. Photosynthesis data will be compared to other parameters measured simultaneously (soil respiration, soil water content, soil temperature, plant height).

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