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No-till improves photosynthesis water use efficiency and photosynthetic nitrogen use efficiency of winter wheat

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Abstract:

Crop productivity is mainly determined by the availability and efficiency in the use of limiting resources such as water and nitrogen (N). The efficiency with which these resources are used in the assimilation process is expressed through photosynthetic nitrogen use efficiency and photosynthetic water use efficiency.

Improving nitrogen and water use efficiency in agriculture appears as an argent imperative for increasing crop productivity. Conservation agriculture based on no-tillage becomes a current tendency to enhance crop productivity by improving soil N recovery, soil organic matter content and soil water content.

In the present study wheat plants were grown under tillage and no- till conditions, with and without cover crops under no and high nitrogen fertilization conditions, to evaluate the combined effect of tilling, cover crops and N fertilization on photosynthetic nitrogen use efficiency and photosynthetic water use efficiency through its impact on leaf physiological traits, such as photosynthesis rate, stomatal conductance, transpiration rate, leaf area ratio and specific leaf area. The flag leaves of four plants during the anthesis period from each treatment were used for leaf gas exchange. Gas exchange parameters were measured on the youngest fully expanded leaf of the main culm, using a LI-6400XT (LI-COR Biosciences, Lincoln, Nebraska 68504, USA) portable photosynthesis system equipped with the 2 cm^2 LI6400-02B chamber.

Six years after conversion to no-till, in the presence and in the absence of cover crops, significant increases in water use efficiency and soil water content were observed both under no and high N fertilization conditions. Moreover, we observed that photosynthetic nitrogen use efficiency, photosynthesis rate and specific leaf area were higher under no-till conditions compared to conventional tillage.

Thus, agronomic practices based on continuous no-till appear to be a promising for increasing photosynthetic nitrogen use efficiency and photosynthetic water use efficiency in wheat.

Recent Publications

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4. Hirel, B., T. Tétu, P.J. Lea, and F. Dubois. 2011. Improving Nitrogen Use Efficiency in Crops for Sustainable Agriculture. Sustainability 3(12): 1452–1485.
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