Describing Nitrogen dilution curve and physiological behavior of *Thinopyrum intermedium*

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ABSTRACT
The perennial grain crop, *Thinopyrum intermedium* ((Host) Barkworth & D.R. Dewey) can provide various ecosystem services. Among them we can mention preservation services such as the reduction of nitrate leaching, the improving of soil food webs or the carbon pools and sequestration as well as a dual production of grains and forage. Currently, *Th. intermedium* is characterized by a recent selection history and its resource allocation to grains is low and variable. At the same time, its perenniality leads to large resource allocation to the belowground organs composed of short rhizomes and a deep root system to ensure crop continuity. Consequently, the development of intermediate wheatgrass in cropping system is still impeded by grain yielding capacity and stability, and knowledge gaps about best management practices in fields. To improve yields and crop management, a good description of its physiological behavior and a better understanding of its growing habits are yet required. Through the determination of its critical nitrogen dilution curve, we aimed to characterize its nitrogen (N) requirements and to establish diagnoses of the N status of the crop in different climatic and agronomic conditions which will allow further to inform fertilization practices to optimize crop growth and yields in fields. A field experiment was conducted in Gembloux AgroBio-Tech, Belgium, for three growing seasons with nitrogen fertilization schemes differing in frequency and amount of N. Globally, N fertilization has a positive impact on the dry matter of leaves, stems and ears ($P<0,05$). The maximization of the aboveground biomass and N uptake was obtained with a fertilization comprised between 100 and 150kg N/ha over the entire growing year. In addition, fall fertilization could be integrated into the N management strategy of the multi-annual *Th. intermedium* crop. Indeed, a fall nitrogen application combined with an early spring application resulted in relatively similar aboveground production levels of the crop as a full early spring nitrogen application. The total aboveground biomass tended to increase along the crop cycle. At the grain harvest, it ranged from 7,0 to 16,4T DM/ha for a 100kg N/ha fertilization, depending on the growing season. The N content tended to decrease with the evolution of growing stages, as observed with the proposed critical nitrogen dilution curve. It also indicates a reduced level of N nutrition that can be linked to several life traits of the crop. Actually, we observed a strong decrease in the leaves/stems ratio after the beginning of the growing season. In addition, the study of Sprunger *et al*. (2018) reported that the nitrogen use efficiency of *Th. intermedium* is high, considering the N content of the whole plant, and the plant seems able to assimilate large quantities of nitrogen and even more than what has been applied. Its deep and dense root system allows an extensive exploration of the soil profile which can further increase the nitrogen use efficiency and reduce nitrate leaching. This

combined with the observed decrease of the N amount of the aboveground biomass in the second phase of growth is discussed in relation with the long-term survival strategy of the crop resulting in substantial investments in perennial belowground structures coupled with reduced resource allocations to seeds. Indeed, storage in rhizomes and roots can be part of a resource-conservative strategy of *Th. intermedium* that could store a part of the N absorbed in its belowground organs, which reduces the amount of N within the aboveground biomass. Sakiroglu *et al*. (2020) found out that the plant is effectively storing non-structural carbohydrates and proteins in its roots and rhizomes.

REFERENCES

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