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BIOCHEMICAL MARKERS OF PHYSIOLOGICAL ADAPTATION IN *Panicum virgatum* L. AS INDICATORS OF STRESS RESILIENCE

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Climate change and increasing environmental pressures have intensified the demand for perennial bioenergy crops capable of maintaining stable productivity under adverse growing conditions. *Panicum virgatum* L. is recognized as one of the most promising perennial C4 grasses due to its high biomass productivity, broad ecological plasticity, drought tolerance, and ability to thrive on marginal lands. The physiological status of plants following overwintering and throughout subsequent developmental stages largely determines their adaptive capacity, biomass accumulation, and long-term resilience. Consequently, biochemical parameters associated with nitrogen metabolism may serve as reliable physiological markers for assessing stress tolerance and optimizing cultivation practices. The aim of this study was to evaluate the dynamics of nitrogen-containing compounds in *P. virgatum* grown under different plant nutrition areas during the principal developmental stages and to determine their relationship with physiological adaptation. Field experiments and biochemical analyses were conducted at the experimental plots and biochemical laboratory of the Department of Cultivated Flora, M.M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine using the switchgrass cultivar '*Zoryane*'**.** Plants were cultivated under three row spacings (24, 45, and 70 cm), representing different nutrition areas. Total nitrogen content was determined in roots, leaves, stems, and panicles during the tillering, panicle emergence, flowering, and fruiting stages using the Kjeldahl method with a KDN-04D Kjeldahl Digestion Unit.

The results revealed pronounced organ-specific and developmental changes in nitrogen metabolism. During the tillering stage, the highest nitrogen concentration (2.07%) and crude protein content (11.82%) were recorded in the combined leaf and stem biomass at a row spacing of 70 cm, indicating enhanced metabolic activity during intensive vegetative growth. At the panicle emergence stage, nitrogen accu-

mulated predominantly in leaves and panicles, whereas stems consistently exhibited the lowest nitrogen concentrations irrespective of row spacing. Root tissues showed a gradual increase in nitrogen content with increasing nutrition area, reaching 1.41% nitrogen and 8.02% crude protein at 70 cm row spacing, suggesting efficient nutrient storage and remobilization prior to reproductive development. During flowering, nitrogen redistribution among vegetative and reproductive organs became more pronounced. Leaves exhibited the highest nitrogen concentration (2.42%) and crude protein content (13.77%) at a row spacing of 45 cm, whereas stems grown at 70 cm accumulated 1.69% nitrogen and 9.64% crude protein, reflecting enhanced assimilate transport and intensified metabolic activity during reproductive development. Overall, wider row spacing promoted greater accumulation of nitrogenous compounds than narrower planting schemes, indicating reduced intraspecific competition and more efficient utilization of environmental resources. The observed redistribution of nitrogen and protein among plant organs represents an important physiological mechanism underlying adaptation to environmental stress. Maintenance of elevated nitrogen reserves in leaves and roots supports rapid restoration of photosynthetic activity following overwintering, whereas efficient allocation of assimilates to reproductive organs contributes to stable seed production and sustained biomass accumulation. These biochemical responses are closely associated with plant resilience and may therefore be considered valuable physiological markers for identifying highly adaptive genotypes.

Keywords: *Panicum virgatum*, nitrogen metabolism, crude protein, stress resilience.

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