

## Leaf Photosynthesis and Water-Use Efficiency of Diverse Legume Species Nodulated by Native Rhizobial Isolates in the Glasshouse

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**Abstract :** Photosynthesis is a process by which plants convert light energy to chemical energy for metabolic processes. Plants are known for converting inorganic CO<sub>2</sub> in the atmosphere to organic C by photosynthesis. A decrease in stomatal conductance causes a decrease in the transpiration rate of leaves, thus increasing the water-use efficiency of plants. Water-use efficiency in plants is conditioned by soil moisture availability and is enhanced under conditions of water deficit. This study evaluated leaf photosynthesis and water-use efficiency in 12 legume species inoculated with 26 rhizobial isolates from soybean, 15 from common bean, 10 from cowpea, 15 from Bambara groundnut, 7 from lessertia and 10 from Kersting bean. Gas-exchange studies were used to measure photosynthesis and water-use efficiency. The results revealed a much higher photosynthetic rate (20.95 μmol CO<sub>2</sub> m<sup>-2</sup>s<sup>-1</sup>) induced by isolated tutpres to a lower rate (7.06 μmol CO<sub>2</sub> m<sup>-2</sup>s<sup>-1</sup>) by isolate mgas 88. Stomatal conductance ranged from 0.01 mmol m<sup>-2</sup>s<sup>-1</sup> by mgas 88 to 0.12 mmol m<sup>-2</sup>s<sup>-1</sup> by isolate da-pua 128. Transpiration rate also ranged from 0.09 mmol m<sup>-2</sup>s<sup>-1</sup> induced by da-pua B2 to 3.28 mmol m<sup>-2</sup>s<sup>-1</sup> by da-pua 3, while water-use efficiency ranged from 91.32 μmol CO<sub>2</sub> m<sup>-1</sup> H<sub>2</sub>O elicited by mgas 106 to 4655.50 μmol CO<sub>2</sub> m<sup>-1</sup> H<sub>2</sub>O by isolate tutswz 13. The results revealed the highest photosynthetic rate in soybean and the lowest in common bean, and also with higher stomatal conductance and transpiration rates in jack bean and Bambara groundnut. Pigeonpea exhibited much higher water-use efficiency than all the tested legumes. The findings showed significant differences between and among the test legume/rhizobia combinations. Leaf photosynthetic rates are reported to be higher in legumes with high stomatal conductance, which suggests that legume productivity can be improved by manipulating leaf stomatal conductance.

**Keywords :** legumes, photosynthetic rate, stomatal conductance, water-use efficiency

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