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Elevated Carbon Dioxide and Soil Moisture on Early Growth Response of Soybean

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Abstract

Interactions between elevated [CO_2] and soil water availability have the potential impact on crops and future food security of the world. The study was conducted to investigate vegetative growth response of soybeans under two [CO_2] (380 and 800 µmol mol^{-1}) with three soil moisture levels in controlled environment. Slow growth rate and altered crop phenology of soybeans were observed under elevated [CO_2] at early stage (V-3/V-4), but showed positive physiologically response at later stage (R3) indicating adoptive mechanism of plants to high [CO_2]. Elevated [CO_2] decreases the number of leaves by 23% and 14% and reduces in leaf areas by 11.7% and 9.7% compared with ambient [CO_2] at 29 and 44 days after planting (DAP), respectively. Adaptive mechanism of plants to high [CO_2] produced 39% and 83.7% greater leaf number and leaf areas, respectively at later stage (R3) of the crop growth (59 DAP). There was a reduction in a specific leaf area (SLA) at 29 DAP (22.2%) but an increase at 44 DAP (1.4%) and 58 DAP (8.5%) under elevated [CO_2]. Dry matter production of plants was increased significantly for elevated [CO_2]. Increase in leaf C (<1%) and reduction in N concentration (6.0% - 9.5%) increased the C:N ratio of soybean leaves (4.4% - 12.98%) under elevated [CO_2]. Elevated [CO_2] with normal soil moisture condition produced a maximum number of pods (54.8% - 122.4%) and an increase in dry weight of pods (29.8% - 56.6%). Plants under elevated [CO_2] produced significantly greater numbers of root nodules per plant by 114% compared with plants under ambient [CO_2] at 44 DAP. These results show a direct and interactive effect of elevated [CO_2] and soil moisture on plant growth that will affect not only the global food security but also nutritional security.