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Plant growth and leaf morphological change of *Spinacia oleracea* grown under different light-emitting diodes

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This study aimed to determinate effects of light-emitting diodes on leaf morphology and growth of two cultivars (world-star and sushiro) of *Spinacia oleracea*. Plants were grown for 25 days after transplanting (DAT) under the LEDs (White (W), Red and Blue (RB, ratio 2:1), Blue (B), Red (R) LED) under the same light intensity and photoperiod (130 μmol m^{-2} s^{-1}, 12 hours). Higher fresh and dry leaf weights, leaf number and leaf area were observed in the world-star cultivar, in which a 35% increase in leaf dry weight was found in both the RB and R LEDs than the B and W at 25 DAT. In the sushiro cultivar, the leaf dry weight was in the order of RB>R>B>W at 25 DAT. Leaf apinasty symptom was appeared in plants grown under both R and RB LEDS with much more severe degree of symptom under the R LED. Microscope analysis indicates that the cell size of leaf margin region was larger than that in the leaf blade region in the apinasty symptom-developed leaf. The chlorophyll content and photosynthetic activity were lower in the leaves grown under the R LED. All the integrated results suggest that the B or W LED is a proper light condition due to the leaf apinasty symptom for a closed cultivation of *Spinacia oleracea*.

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