Problems of Aerodynamic Proportion

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In this project, I wished to determine the best way to increase the efficiency of a wing. I hypothesized that leading-edge wing fences or full-body wing fences would correct wingtip vortices and therefore increase wing efficiency better than increases in aspect ratio or the addition of winglets; and that the NACA 6412 airfoil with miniature-vortex-generators attached would best manipulate pressure differences to increase lift and therefore lift to drag ratio. I used a wind tunnel housing four fans. I used two Vernier dual range force sensors to measure lift and drag of the airfoils; an aneroid barometer to measure the lateral air pressure; and a hand held anemometer to measure wind velocity. From the 1,503 data points I collected from each force sensor for each wing setup, I took the mean values and made lift to drag ratios, which is how I measured wing efficiency. The NACA 0013 wing with leading-edge fences had a peak lift to drag ratio of 71.1; when compared to the original peak lift to drag ratio of 17.8, my first hypothesis is proven correct. The NACA 6412 wing with miniature-vortex-generators did not increase wing efficiency; although they did increase lift on both the NACA 0013 and NACA 6412 airfoils, they increased drag more so than lift by creating a low pressure region behind the wing; this proves my second hypothesis incorrect. I conclude that attaching leading-edge fences to the leading edge of aircrafts' wings will increase wing efficiency and therefore fuel efficiency.