Many plants are known to produce and emit distinct bouquets of volatile compounds from their leaves and roots following stress events such as insect herbivory. These volatiles can be detected by natural enemies of herbivores, and by nearby plants. However, little is known about the effect of plant volatiles on seeds. Seeds may lay dormant for years in the soil, and potentially be exposed to a range of plant-derived volatiles. Our objective was to investigate growth and reproductive effects of plants exposed as seeds to plant-derived volatiles. We followed the growth and reproduction in two consecutive generations following a single experimental exposure of plant volatiles to seeds of the model plant *Arabidopsis thaliana*. Remarkably, both first and second-generation plants were impacted by volatile exposure to the initial seeds. Seed exposure to specific volatiles inhibited primary root growth, lateral root development, yielded smaller plants with lower leaf count and lower fresh biomass of both first and second generations of plants. This work increases our understanding of the long-lasting effect of volatile exposure to seeds on future plants across generations. Moreover, to our knowledge, this is first documented evidence that volatile exposure alone can impact plant growth across generations. Future work will evaluate epigenetic mechanisms for our observed trans-generational effects of plant-derived volatiles on seeds.