Development of the Lucky Clover: Effects of Phosphate and Auxin on the Number of Leaflets in White Clover

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White clover (Trifolium repens) has compound leaves, usually with three leaflets. The plant occasionally produces leaves with four leaflets, the so-called four-leaf clover, which is a symbol of good luck. Genetic factors and injury are thought to be factors in the development of four-leaf clovers, but the mechanism remains unknown. Based on my observations, four-leaf clovers tend to be found in areas where clover grows well. In this study, examination of different soil nutrient conditions showed a higher incidence of four-leaf clovers in phosphate-rich conditions. Morphological observation of the vascular bundles showed that there are five sets in the petiole irrespective of the number of leaflets. However, it was found that vascular bundles reconstructed at the branching site from petiole to petiolule and that the number of vascular bundles in the petiolule was related to the number of leaflets. Thus, increased phosphate concentration in the plant tissue and increased vascular bundle development at the branching site from petiole to petiolule increased the incidence of numerous-leaflet clovers. Phosphate is known to be involved in auxin function, which plays a role in vascular bundle development. In a further experiment, spraying auxin on clover grown under high phosphate conditions doubled the production of four or more leaflet clovers compared to control (high phosphate only). These results suggest that four or more leaflet clovers are produced by activation of auxin in the presence of high phosphate with enhanced vascular bundle development. These findings may contribute to the development of methods to artificially control the number of leaves on plants.